JUNE, 1916 10 CENTS

The Electrical Experimenter

POPULAR ELECTRICAL NEWS ILLUSTRATED

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the same words in the same tone of voice can make the sound carry farther than if both shouted in different tones. In the same way, wireless receivers have a greatly increased range if both of them are exactly matched in tone. You have less trouble getting "in tune" with the sender and you get the signals much clearer. The long distance records made under these conditions are surprising. That is the way Brandes Wireless Head Sets are made—both receivers closely matched. In addition, they are easily adjustable and yet so rigid, when once adjusted to your comfort, that they never slip nor irritate.

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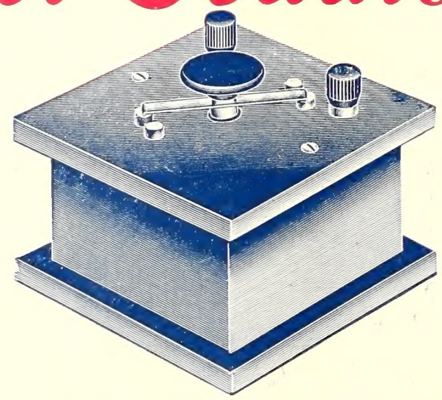

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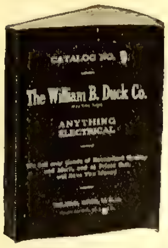

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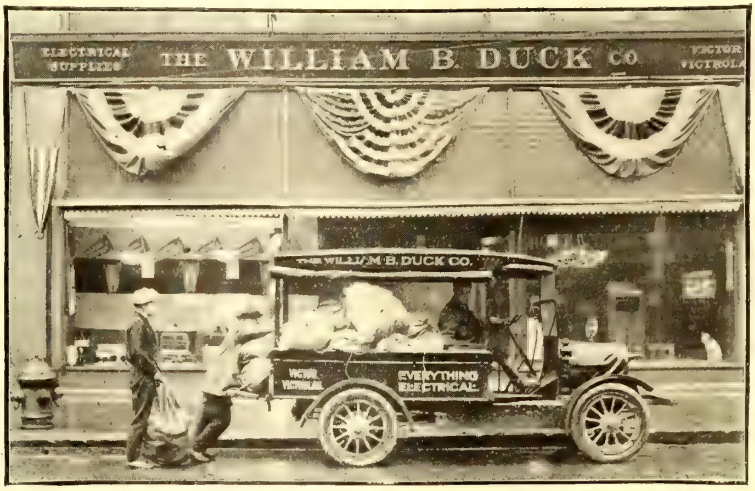

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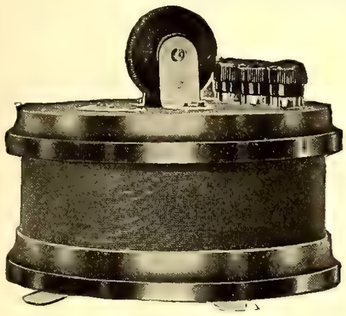

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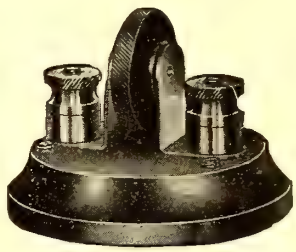

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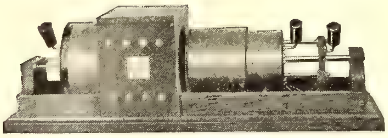

PRECISION VARICOUPLER TYPE AML

This instrument combines great range with wonderful accuracy and handsome appearance. Highly efficient on undamped waves. Will receive amateur, ship, navy and long wave trans-atlantic stations with our loading coils below. Range—2,000 meters, size 7″ x 7″ x 23″, finish Mission oak, hard rubber, silver finished coils.
Price..................................$20.00

ALL Precision apparatus here shown gives you absolutely accurate adjustment without the use of switches or sliders. Precision Varicouplers have no "dead ends," no taps, and can be used without variable condensers. They have a remarkable beauty which appeals to you on sight, and present a fine appearance on your instrument table. Acknowledged by all experts to be the superior tuners.

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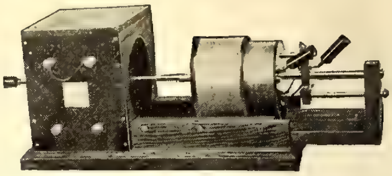
These prices are good for 30 days only; our former prices have been reduced, in order to universally introduce the present Precision products, as illustrated on this page, within the shortest possible time.



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Specially designed for long wave amateur reception on oscillating audion circuits. Extremely loose coupling, wonderfully accurate adjustment high efficiency, handsome appearance. Range 100 to 600 meters. Finish, Mission oak, hard rubber, silver finished coils. With this tuner you can pick up amateurs hundreds of miles away. Size 7″ x 7″ x 13″ closed.
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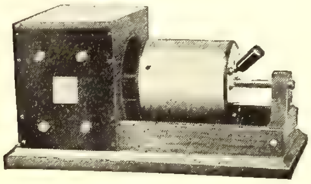

PRECISION VARIOMETER TYPE M

Embodies a new idea in variometers. Extremely accurate adjustment, high efficiency, appearance to match all other Precision instruments. Three times the range of any other variometer. Finish Mission oak, genuine hard rubber trimmings and panel, silver finished coils. Size 7″ x 7″ x 23″.
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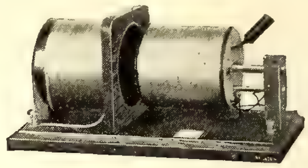
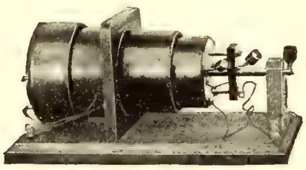


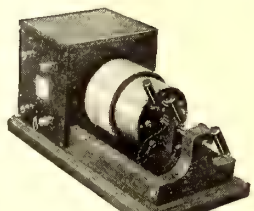
PRECISION VARIOMETER TYPE S

Same design and range as our Type M, finish Mission oak, hard rubber, silver finished coils. Has greater range than any other variometer at the extremely low price of..............$6.00



PRECISION VARICOUPLER TYPE AMS

This instrument is similar in size and range to our Type AMM but is designed with a view to making a Precision Varicoupler of wide range and great efficiency as well as handsome appearance at a very low price. This instrument will do extremely fine work and presents a fine appearance on the instrument table. Size 7″ x 7″ x 23″, finish Mission oak, hard rubber, silk covered wire. Range 100 to 600 meters.
Price..................................$14.00



PRECISION VARICOUPLER TYPE AMM

This tuner is similar to our type AMR but the secondary is not detachable from the primary. Range 100 to 600 meters, designed especially for amateur, commercial and navy work. Finish Mission oak, hard rubber panel and trimmings, silver finished coils, metal parts heavy nickel plate on brass. This instrument is a highly efficient and handsome Precision Varicoupler at a moderate price. Size 7″ x 7″ x 23″.
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Designed especially for reception from long wave undamped and damped stations. Wound with silk covered copper wire on specially treated tube, genuine turned oak base and top, seven sections with nickel plated binding posts and flexible connecting cord with hard rubber handled plug. May be used with any of our varicouplers.
No. 941 for primary.........$6.00
No. 942 for secondary......$6.40
Size 36″ x 4½″

USE THIS SLIP NOW
You may intend to use it before the 10 days are up and forget.

Precision Radio Equipment Co.
868 Putnam Ave., Brooklyn, N. Y.

Gentlemen:

Ship immediatly express collect one Precision Varicoupler, Type N, at your 10-day price of $3.50 for which I enclose money order. If I decide to get one of your de luxe Varicouplers within three months you hereby agree to accept the one ordered now as part payment to the extent of $3.50.

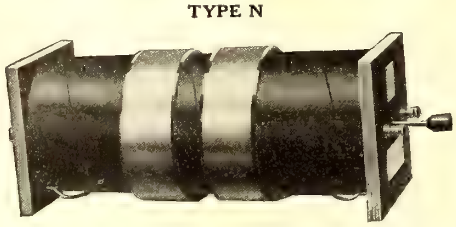
Name..................................

Address..................................

City and State..................................

EXTRAORDINARY ANNOUNCEMENT

TYPE N



AFTER months of experiment we have at last succeeded in developing a Precision Varicoupler at such a low price that even the amateur who now wishes to make only a very small investment may secure one of our remarkable instruments. This instrument has a range equal to our type AMM and has primary and secondary adjustment without sliders or switches; has no dead ends or taps, and consequently has wonderful efficiency. The tubes are specially treated, all the wire used is genuine silk covered copper wire, all metal parts are heavily nickel-plated and the woodwork is mahogany finish. Adjustments are provided with hard rubber handles and the instrument is securely made and well finished. A remarkable instrument at an unheard of price. Size 13″x 5″x 5″. . . . . . **$3.50 for 10 days only.**

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General Office: 868 Putnam Avenue - - BROOKLYN, N. Y.

The Electrical Experimenter

233 Fulton Street, New York.

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Vol. IV Whole No. 38 **CONTENTS FOR JUNE, 1916** **No. 2**

Ether

A FISH swimming in the water, his natural element, is not conscious of the fact that he lives in any particular medium. Before you were six years old you did not realize that you lived in a similar medium, the same as does a fish. In this case, however, the medium is air instead of water. Having been born surrounded by air and having lived in air for several years, you never were conscious of the fact that you were walking daily in a gaseous, tho invisible fluid, compressing you with a force of 14.7 pounds on every square inch of your body. Just as the fish does not "feel" the water in which he swims, so we in turn do not realize at once that we are living in a comparatively dense medium also.

Let us remove the water from the lake in which the fish swims. What takes the place of the water? The air, of course. Now let us take away the air, too. What remains? A vacuum, the layman will say. But what is *in* the vacuum? A void? Nothing?

Here the scientist steps in and speaks an emphatic "No."

There can be no such thing as a void. The vacuum is only a vacuum as far as the air is concerned, but the space which contained the air before and which we prefer calling a vacuum is entirely filled with ether.

It is true that we have no sense by which we can detect the presence of the ether, but we know today that it must exist. Nor are proofs lacking. We know that energy cannot be transmitted from one point to another without a medium to conduct it. Thus for example if we place an electric bell under a glass jar we can hear it ring through the glass. If we pump out the air from the glass jar we can no longer hear the bell, for we have taken away the medium—in this case the air—which sound requires to travel thru from one point to another.

Similarly, light requires a medium to travel from one point to another, but what is the medium? It certainly cannot be air, for you can look right through an ordinary incandescent light bulb in which there is a high vacuum. If light were dependent on air, you could manifestly not look thru the bulb, *ergo* the medium is not the air, it must be something else. The medium is the ether, properly called the luminiferous ether. It is an indefinable "fluid," so fine and so impalpable, that our most ingenious instruments have never been able to detect it directly. It fills every inch throughout the universe, it fills the interplanetary space as well as it fills your body. Briefly the ether fills and permeates *everything;* the same as water fills the interstices between the individual grains of a handful of sand. There is this difference however: the water does not fill all of the interior of the sand grains, while the ether does.

We know that ether has no weight, on the other hand we know that it has a certain amount of inertia because time is required for the propagation of its waves—the ether waves traveling at the rate of 186,000 miles per second.

Ether is the modern magic wand of the scientist. By its means our most inexplicable phenomena become at least plausible and can be understood. Thus we know that if we take a minute piece of matter—an atom—and vibrate it rapidly, the ether, which is a sort of weightless jelly, produces certain waves. If we vibrate the atom rapidly enough we produce light. A variation in the speed of the vibrations of a given atom will produce all sorts of manifestations, be they heat waves, light waves or electromagnetic (wireless) waves.

All of these waves are fundamentally one and the same thing; they only appear different due to their atoms vibrating either slower or faster.

It is with these ether vibrations that our scientists will be concerned in the future.

H. Gernsback.

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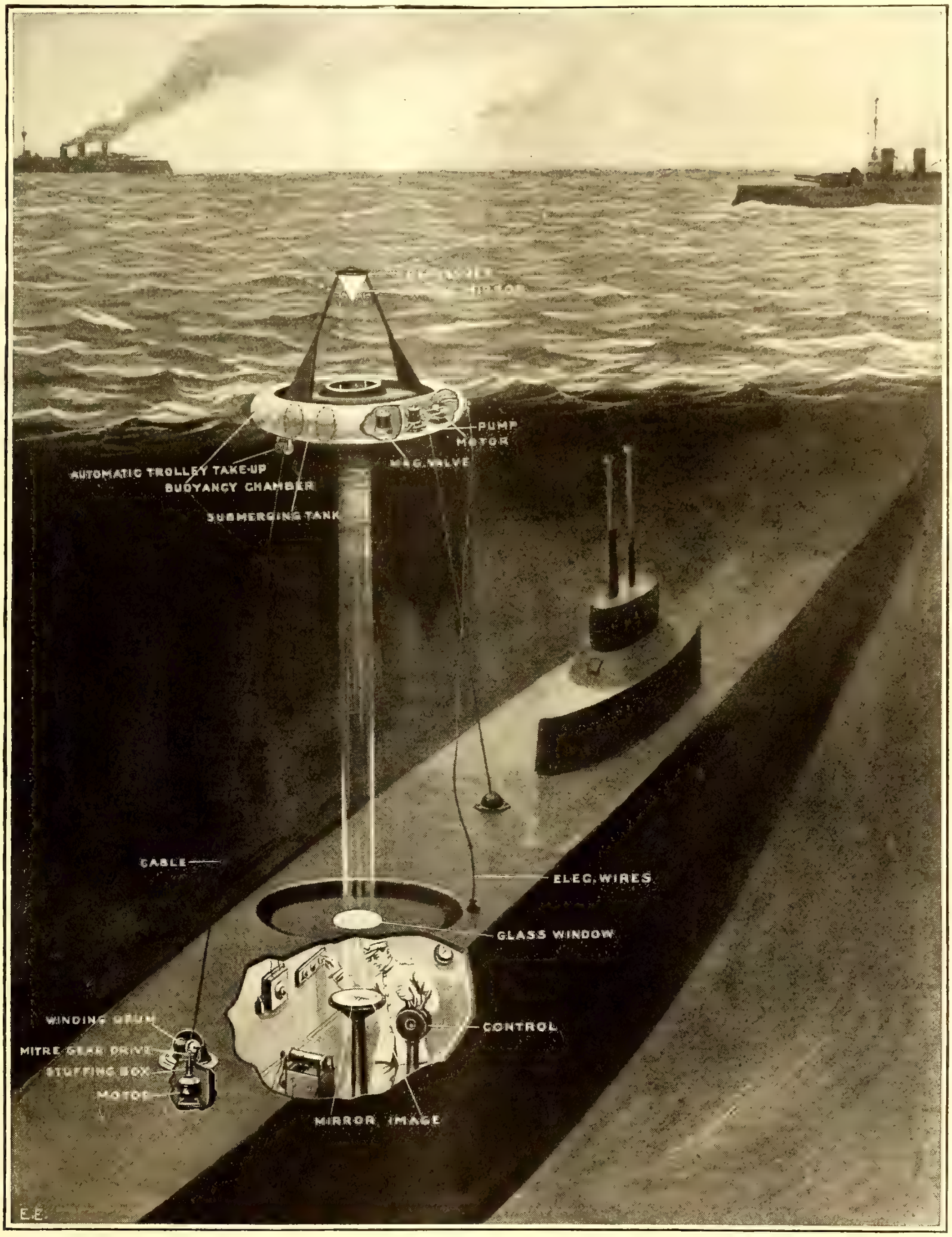
THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. IV. Whole No. 38 JUNE, 1916 Number 2

An Auxiliary Periscope for Submarines

THE most vulnerable part of the present submarine is its periscope. When running submerged with the periscope below the surface of the water, the submarine is "blind," in other words its commander does not know what goes on above the water. If he is not very cautious he runs two separate risks when rising to the surface. One is that the periscope immediately becomes the target for the enemy's shell fire, if his vessels are near the spot where the submarine rose. The other is that frequently the periscope collides with the hull of another vessel, either enemy or friendly. In both cases the result is disastrous, for, as far as its utility is concerned a "blind" submarine though otherwise intact, ceases to exist for the enemy. Of course, the submersible could scuttle away under the water, without coming to the surface even though its periscope had been shot away. This is known as *running it blind*. However, the difficulty is not that it cannot get away in the manner described, but usually, and possibly in most all cases, there is considerable damage effected aside from that to the periscope. In other words, it is not the loss of the periscope that endangers the under-sea boat as much as it is the probable damage to the thin steel hull. An extra periscope is undoubtedly available for such contingencies on most foreign submarines. But this is of no avail if the vessel becomes leaky.



Gernsback Auxiliary Periscope for Submarine Use in Reconnoitering. The Image Is Reflected Downward Thru a Glass Window in the Shell of the Submersible.

With this and other objects in mind Mr. H. Gernsback, of New York City, has devised a separate, *auxiliary periscope* for the use of submarine war-craft. The illustration brings out the idea in detail. There is provided a floating air tank of circular form, on which is mounted a conical mirror. This mirror reflects an image of the entire horizon downward through the water on a second (flat) mirror located within the submarine as the illustration clearly shows. In this way no danger from shell-fire is incurred, as far as the hull of the craft is concerned. If the auxiliary periscope is destroyed by the enemy, the submarine may be navigated submerged or it may remain in the location, venturing upward cautiously after an hour or so, and the usual periscope now comes into play. It is possible also to equip each submarine with this apparatus designed by Mr. Gernsback. The submarine's chances of foiling the enemy are increased a hundred-fold.

We may now consider the details of the auxiliary periscope, as proposed. To begin with the floating tank carrying the conical mirror can be submerged, like the submarine itself. This is accomplished by the electric control of a sea-valve installed on the under side of the floating chamber. When opened, it floods a separate compartment with water, causing the device to sink. To make it rise an electrically operated pump, mounted within the buoyancy chamber, is started up. The sea-valve now being closed, the water in the submerging tank is soon pumped out. A check valve in the efflux pipe from the pump prevents the sea-water from backing up into the apparatus.

Attached to the floating mirror pontoon are two wire cables, which may be wound up on suitable drums, driven by electric motors within the submarine hull. These motors operate the cable winding drums through bevel gears; the shafts of the motors passing through water-tight stuffing boxes. To compensate for the rise and fall of the floating pontoon, if so we may term it, owing to a choppy sea, there are provided two automatic cable take-up reels, secured to the upper end of each winding cable. These reels act in a similar manner to those used on trolley cars for automatically taking up the slack in the trolley rope.

In order to haul in or lower the auxiliary periscope to its resting place especially provided at the top of the submarine, the sea-valve, regulated by an electromagnet, is opened to admit water to the submerging chamber, and by operating the electric motors connected to the wire cables the device is pulled downward into its proper place. To release it, the pump motor is started, which, emptying the water tank, renders the pontoon buoyant again. The cable motors are released to permit the auxiliary sighting device to float upward by its own buoyancy.

The circular form of the pontoon and its central orifice tend to give reasonable steadiness unless the sea happened to be very choppy. By squirting oil on the sea the waves may be made to subside appreciably. Most important of all, it does not matter if the float and its conical reflector do bob around slightly, as the sighting accomplished by its aid is only intended for general reconnoissance and *not* for determining the exact range of an enemy vessel so as to torpedo her. Its primary purpose is, therefore, to render an inspection of the sea above the submarine a safer operation than where the usual periscope is utilized for the purpose, as if this happened to be shot away by a nearby warship the chances are that part of the hull plates would be damaged also, and the unlucky crew sent to their eternal resting place—Davy Jones' locker.

RADIO CONTROLLED TORPEDO IN THE MOVIES.

WHAT would we do to-day if a foreign country invaded this land? Our army and navy at present are not very suitable for defensive and offensive work, and the quantity of ammunition which we have to-day is perhaps not sufficient for carrying on actual warfare for any appreciable period. The only way the invader can be checked from entering the country is by employing some defensive means that does not require a large number of trained men. For example the utilization of projectiles that can be fired and controlled at a considerable distance. It is possible to control a torpedo of either the aerial or water type by *wireless*, but although enormous sums of money have been expended by various inventors in an effort to develop a satisfactory radio-controlled torpedo, totally satisfactory results have not been obtained up to this time. In spite of the fact that, although the inventors were not successful in perfecting such a torpedo, a "movie" concern has already produced an elaborate and realistic film showing real aerial torpedoes controlled by wireless. This exciting film, "The Flying Torpedo," was produced by the Triangle Film Corporation. The picture is supposed to illustrate events in 1921, when the United States Government learns of a secret coalition of foreign powers against it. A technical advisory board, composed of the leading American scientists, is organized for the defense of the country. They encourage the invention of contrivances for destruction and defense and offer prizes for the best death-dealing machines developed.

Winthrop Clavering, an alert and ingenious writer of detective stories, reads of the offer and calls the attention of his friend, Bartholomew Thomson, an inventor, to the item. Thomson has previously completed a wireless control mechanism with the financial assistance of Clavering. One of the needs suggested by the board is a *guided* aerial torpedo. Clavering urges Thomson to invent the desired torpedo and provides the necessary funds. Immediately experiments are started by Thomson and William Haverman, his assistant.

After spending a considerable amount of time and money the first experimental torpedo is built and made ready for a trial. It is assembled out in a secret place and the parts are all properly tuned up. Fig. 1 shows the testing arrangement. (In the movies they do it!)

Fig. 1. How the Inventor in the "Movies" Develops a Radio-Controlled Torpedo. Fig. 2. One of the Aerial Torpedoes Ready for Launching. Fig. 3. Interior of Control Station. Fig. 4. The Radio Torpedo Destroying the Enemy.

Later the United States is invaded by the foreign hordes, who effect a landing in Southern California. The valiant defense by the navy with the submarine torpedoes controlled by wireless keeps the enemy from our coast on both the Atlantic and Pacific. The invasion of California, however, sets the country in a panic. Clavering and the young inventor lose no time. They co-operate with the Government experts for the manufacture of great quantities of aerial torpedoes provided with *wireless control.* In a short time they are transported to California, and stationed out of range of the enemy's guns. Naval and land battles have been lost repeatedly by the insufficient American forces. Fortresses are demolished and great stretches of territory speedily occupied by the enemy. At a critical moment the new torpedoes are launched by the young inventor and his assistant. Fig. 2 shows a group of soldiers holding the radio-controlled torpedo ready for launching. When the propeller is released by a signal from the inventor (suitably protected at the radio control station. See Fig. 3), the missile darts towards the enemy. An ingenious device is employed in observing the course of the missiles. It is an *electric periscope,* supported by kites, from which connections are brought to an observation apparatus in the operating room. In the illustration at Fig. 3 the operators are using this periscope. In Fig. 4 one of the radio-controlled torpedoes is seen darting downward on the enemy.

According to the pictures, these torpedoes saved the country from the enemy.

DATE OF ISSUE.—*As many of our readers have recently become unduly agitated as to when they could obtain The Electrical Experimenter, we wish to state that the newsstands have the journal on sale between the fifteenth and the eighteenth of the month in the eastern part of the United States and about the twentieth of the month west of the Mississippi River. Our subscribers should be in possession of their copies at these dates. Kindly bear in mind, however, that publications are not handled with the same dispatch by the Post Office as a letter. For this reason delays are frequent, therefore kindly be patient and do not send us complaints as to non-arrival of your copy before the twenty-fifth of the month.*

Electricity and the Weather Man

By Samuel Cohen

"WHAT will be the weather to-morrow?" is the continuous question asked by millions of people all over the country, and this is most accurately answered by the Government weather forecaster.

One can not imagine offhand perhaps the important rôle electricity plays in operating the various delicate weather recording instruments. However, it would be nearly impossible for the Weather Bureau to operate successfully the different sub-stations if electricity was not employed. Practically every conceivable instrument used by the bureau is operated by electricity.

Some of the most important weather forecasting instruments are shown in Fig. 1. These are placed outdoors (on the roof) and the electrical connections of each are brought separately to the recording instruments, which are shown in Fig. 2. Coming back to the outdoor instruments, at the extreme left of the photo are *dry* and *wet* bulb thermometers used for determining the humidity or the amount of moisture in the air. Because of the varying rates of evaporation of moisture from the wet bulb thermometer, which would tend to give a false reading, the instruments are whirled rapidly when the record is taken, so that the evaporation is always at the fastest rate possible.

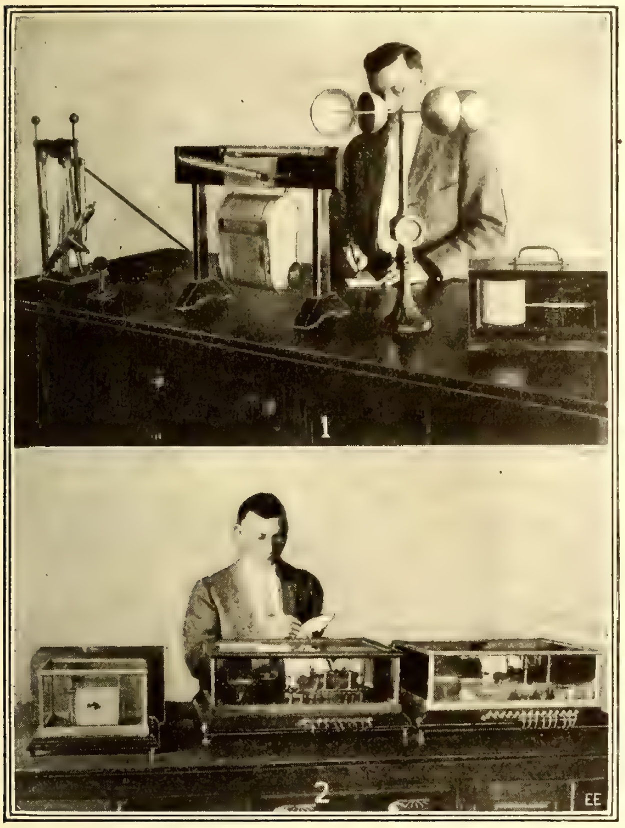


Fig. 1 (Top):—At the Extreme Left are the Dry and Wet Bulb Thermometers for Finding the Humidity of the Air. Because of Varying Rates of Evaporation of Moisture from the Wet Bulb Thermometer with Consequent False Readings, the Instruments are Whirled Rapidly when the Record is Taken. Next Comes the Sunshine Gauge Which Records in the Office Below, Exactly the Duration of Sunshine. Next is the Minimum (top) and Maximum (bottom) Thermometers, That Give the Lowest and Highest Temperature Each Day. Below is a Kite Meteorograph Used for Recording Conditions of the Upper Atmosphere, When it is Sent Up on a Kite. Next to the Right is the Anemometer or Wind Gauge. At the Extreme Right is Shown the Barograph Which Records the Continuous Barometric Pressure.

Fig. 2 (below):—The Instrument at the Left Gives a Continuous Record of the Weighing Rain and Snow Gauge. Next is the Triple Register or Station Meteorograph, Which Records the Action of the Wind Vane, the Anemometer (wind velocity), the Sunshine Gauge, and the Rainfall as Told by the Tipping Bucket Gauge, All of Which Instruments are on the Roof Above.

The glass tube, set at an angle, next to the humidity instruments is a sunshine gauge, an ingenious instrument that records exactly the duration of sunshine. This apparatus consists of two tubes, one of which is placed inside the other. The outer tube is partly exhausted. The inner one is made similar to a dumb-bell, but instead of having globes on the end, it has cylinders. The lower one is coated with lamp black to absorb the sun's heat. The lower tube is filled with mercury to about three-eights its capacity, while the upper one contains alcohol used for lubricating this mercury. The center portion of the tube contains two sealed-in platinum wires, which are connected to the recording instrument. Now it is evident that whenever the sun shines on the sooted portion of the tube the absorbed heat will expand the air in the bulb and thus cause the mercury to rise. As soon as it rises to a certain height it will short-circuit the two sealed-in platinum wires and thus complete the recording circuit.

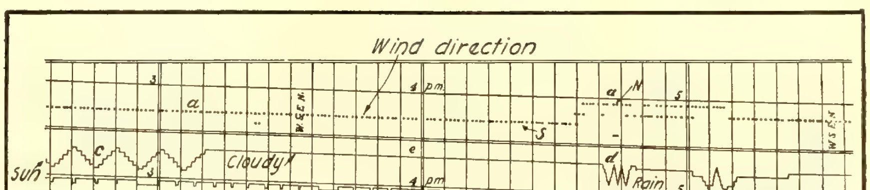
The two thermometers on the stand at the center comprise a minimum (top) and a maximum (bottom) thermometer, which indicate the lowest and highest temperature each day. Underneath is a kite meteorograph, used for recording conditions of the upper atmosphere. The velocity of the wind is measured by an anemometer; this is perceived standing at the right of the kite meteorograph. It consists of four aluminum buckets set at right angles to each other and supported by a suitable frame. The cups when revolved by the wind cause the rod, which is enclosed in the tubular upright, to operate a gear arrangement placed in the lower portion of the instrument. The gear is so made that whenever the buckets revolve at a speed of 500 times per minute a centrifugal device makes contact with an electric terminal which is connected to the recording instrument. It is, therefore, obvious that the number of turns of the cups per minute determine the velocity of the wind. The greater the velocity of the wind, the more times the recording circuit will be made and thus in turn the recorder will make its record faster.

At the extreme right is shown the barograph, an instrument which records the continuous barometric pressure.

The rain and snow gauges are not shown in the illustrations but are also important instruments to the weather man, as they determine the amount of rain and snow that fall during a certain period of the day. The rain gauge consists of a circular chamber, covered with a funnel which leads to a double bucket, delicately supported. A spring contact is so placed underneath the bucket that whatever bucket falls, it will depress this spring which touches another electric terminal connected to the recording instrument. The buckets are so adjusted that one-hundredth of an inch of rain will upset the equilibrium of the bucket, thus causing it to fall and in so doing complete the recording circuit. It is thus quite clear how the weather man is enabled to determine exactly the amount of rain that falls each day.

In determining the amount of snow that falls during a certain period, a unique machine is used which consists of a copper pan placed upon a special scale. The scale is so adjusted that one-hundredth of an inch of snow will upset it and in so doing causes two terminals to touch, which are connected to the recording instrument. An arrangement is placed on the scale whereby the balance is set to the zero position when additional snow falls into the copper pan. This consists of a weight placed on the scale lever which is automatically shifted on the scale lever by a ratchet operated by an electromagnet when the depression of the pan closes the circuit. Thus an accurate reading can be obtained by the use of this snow recording instrument.

The recording instruments (Fig. 2) are placed indoors. The instrument at the left gives a continuous record of the rain and snow gauge. Next is the triple register or station meteorograph which records the action of the wind vane, the anemometer (wind velocity), the sunshine gauge and the tipping bucket gauge. The recorder itself consists of a drum carrying a paper chart upon which different records are made. The drum is revolved by a spring motor. Ink pens, controlled by electromagnets, are actuated by the various outdoor instruments. A portion of an actual record taken by the triple register or station meteorograph is given in Fig. 3. The record of the wind direction appears at aa. The velocity of the wind is shown by the lateral deflection of the velocity record at b. Each ten miles is marked by a relatively broad deflection. Duration of sunshine is recorded by the zigzag trace at c; rainfall, by the line d. The line e indicates cloudiness or the absence of either rainfall or sunshine.

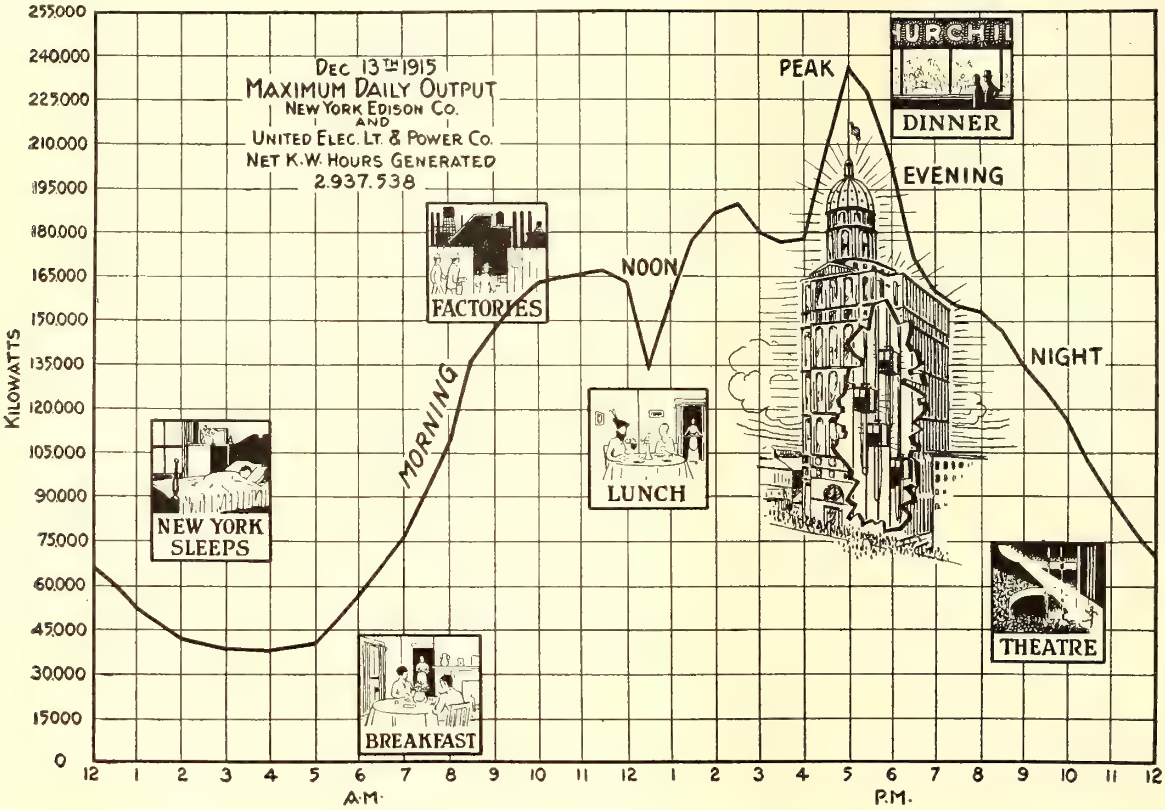


Typical Weather Chart as Automatically Registered on Apparatus Shown at Fig. 2. It Registers Wind, Direction and Velocity, Rain, and Sunshine.

When New York City Turns On the "Juice"

By H. Winfield Secor.

WHEN the average New Yorker turns on his electric lights or power motor, he possibly does not stop to think once in a thousand times as to what effect this small quota of electrical energy has on the gross amount used in the entire city of Greater New York with a population of over 5,000,000 people. Again it is just as possible that he does not stop to think once in ten thousand times as to the effect of turning on the electric lights at any certain time of the day or night. The graphic curve, as it is termed among engineers and illustrated herewith, shows how the demand for electrical energy both for illumination and power consumption varies during the complete cycle of twenty-four hours, starting in this particular instance at midnight of Sunday, December twelfth, and ending at midnight Monday, December thirteenth. This curve covers the combined total daily output of both the New York Edison Company and the United Electric Light & Power Company. The two corporations supply all of the electrical load for the metropolis exclusive of subway, surface and elevated train requirements which are cared for by private central stations owned by the companies operating these traction systems.



This Graphic Curve Shows in a Remarkable Manner How the Demand for Electricity in New York City Varies During the Twenty-four Hours. First the Factories, Then the Theatre Matinees, Business Offices, Elevators, Electric Signs and Restaurants Help to Boom the Demand for "More Juice."

Starting at midnight, as indicated by the point on the curve at the extreme left, we see that the total motor and illumination load of the entire city was about 65,000 K.W. (kilowatt equivalent to 1⅓ H.P.). As the wee small hours of the morning progress, the demand falls off until it reaches the lowest point of the whole cycle of twenty-four hours with a kilowattage of 37,000. This ebb tide point starts to move upward, as observed, after four in the morning, or about the time the milkman begins to make his rounds and when a considerable portion of the city's working people have risen, and for the time of year here under consideration the fairly rapid increase of energy consumption from this point on to seven o'clock is due to the great demand for electric lights during the breakfast period.

A great many of the large manufacturing establishments and factories start work at 7 a.m. or at least by 8 a.m., and the load curve goes shooting skyward at a rapid rate as the illustration depicts. Now the thousands of office employees are arriving and the elevators in the towering skyscrapers of the greatest city in the world are taxed to capacity. These require a larger amount of energy than is popularly imagined and consume no small part of the total load component for the day.

The central and sub-stations scattered about the city have been the scene of great activity during these hours of increasing demand for current in one form or another, and dynamo after dynamo has had to be switched on to the city's feeder lines in order to care for the enormous demand now created. Just before the noon hour arrives, the maximum peak for the morning load has occurred. The maximum total output at this period of the day has reached 166,000 K.W. The curve starts to fall away at this period just before reaching twelve, presumably due to the fact that the many thousands of factory employees have started to wash their hands preparatory to assimilating their noon repast, and directly after twelve the curve makes a decided drop of *33,000 K.W. in thirty minutes.*

As many of the manufacturing establishments have from one-half to three-quarters of an hour nooning, the load curve begins to crawl skyward again and shortly after 1 p.m. it has attained the same value as that existing before the noon drop.

As perceived the afternoon load reaches a much higher value than the maximum demand during the morning hours. Now the theatres have started to open their doors and contrary to the olden days in the greatest theater city on earth, most of the playhouses now run matinees owing to the great spread of the moving picture craze. The theaters are one of the greatest consumers of electrical power, both directly and indirectly, in Greater New York. The afternoon section of the curve fluctuates through a value of about 10,000 K.W. until at 4 p.m. it starts on its last steady rise.

Considering the time of year this rapid increase of the curve is to be looked for, as the afternoon and early evening are quite dark. Now all the various manufacturing establishments, stores and restaurants are in full swing together and the final "peak" of the twenty-four hours' load is reached at 5 p.m. This is the most critical moment of the whole day's performance at the central and subsidiary stations; every dynamo is humming to full capacity and every conceivable form of activity is going on in the city. The office and factory workers are homeward bound, the thousands of elevators in public and private buildings are scuttling earthward with their human freight. The restaurants are full to overflowing with dinner crowds and not to mention the thousands of electric lights being switched on in private residences and apartment houses throughout the metropolis.

The maximum peak of the load carries itself well for about one-half hour, when it begins to take a decided slump. In one hour's time there has been a decrease in the maximum demand for electrical energy of 30,000 K.W. As may be imagined this has required some very clever maneuvering on the part of central station operatives and those in charge. As the load falls off, some of the dynamos are shut down and the sky-rocketing load curve has started on its last downward path, never to reach the peak value of 235,500 K.W. again until the morrow.

There continues a brisk demand for electric current, as witnessed by the appearance of the curve, and it hangs grimly in its slow but sure downward movement. At night time is when the 5,000,000 New Yorkers enjoy themselves. Generally a large majority, of course, visit the theaters. These, as well as the hotels, are the leading factors in the evening load component. Broadway's millions of scintillating lights and its thousands of huge signs atop the buildings also consume a respectable amount of current. Even after 10 p.m. the curve drops very doggedly and keeps up a fairly decent appearance up to its starting point, or midnight.

New York is probably the gayest city in the world, not even excluding Paris, and the after-theater supper crowd manages to keep the central stations busy by their demand for illumination in the restaurants

(*Continued on page 142*)

Electricity and Wireless Solve Secret Service Problems

THE illustrations herewith give several views of a Western Secret Service Bureau. This bureau has been extraordinarily active in quickly adapting the latest advances in electricity and wireless to their various needs and requirements. They handle a great many different cases, including murder, arson, burglary and robbery and, therefore, have every opportunity to make use of any scientific aids which may be available.

The exact degree to which an individual may jolt up against the air of mystery that pervades the Bureau's offices may be best described in showing what a suspect would encounter were he taken to the rooms by an officer.

With the door opened half way he is startled by a hissing flash, partly concealed and he does not realize the fact that his photo is being taken. After this he is seated in another office and his photo taken front and profile, his finger marks recorded, every word he says recorded automatically without his knowing it, and his very footsteps on the rug are made part of another record. If he grows fussy over something and attempts to escape he will find every avenue for escape cut off and he will not be able to do much aside from sitting down again, as the various cabinets, brilliant flashing, buzzing and spitting from the numerous electrical appliances in the rooms create an atmosphere of mysticism and uncertainty that will work pretty definitely on the mind of an individual who has transgressed the law and who is aware of the fact that every move he makes, every word he says, the exact shading of his voice, the peculiar nervousness he manifests, the character of his walk, and all other personal characteristics are becoming part of a permanent filing system that will check him up anywhere in the country.

In the general private 'phone system, which has recorders and transmitters so delicate that one does not have to employ the usual ear trumpets or the like, the office has already been connected up with a number of institutions necessary and the service is in perfect working order.

Referring to the illustrations, Fig. 1 depicts the wireless "Revelarophone" switchboard and this is so constructed that with the few switches shown it is possible to operate over ten distinct apparata. Fig. 2 shows the secretary's office in which is installed the "Revelarograph," an instrument that makes a permanent record of all speech taking place on all incoming or outgoing telephone messages, and also verbal conversations that occur in any of the offices. It is claimed that it does almost everything but think. Besides there is a special photographic apparatus mounted in one of the cabinets which will snap a man's physiognomy in three different positions without any attention whatsoever. By means of the lately perfected and marvelously sensitive detectaphones here used it is possible for a person standing in the secretary's office to hear everything going on in any of the other offices, without the use of a receiver or without straining one's ears to catch even a whisper, the reproduced voice emanating loud and clear from the receiver of the instrument. The apparatus may be adjusted to any degree of sensitivity. The chief electrician, Mr. L. S. May, of the Bureau's scientific staff, has also evolved an electrically operated Bertillon photographic apparatus and a wireless telephone of the portable type, which may be carried about in a suitcase. The inventor is observed busily engaged in his private laboratory at Fig. 3. Thus does science slowly reduce the activities and artifices of the underworld.

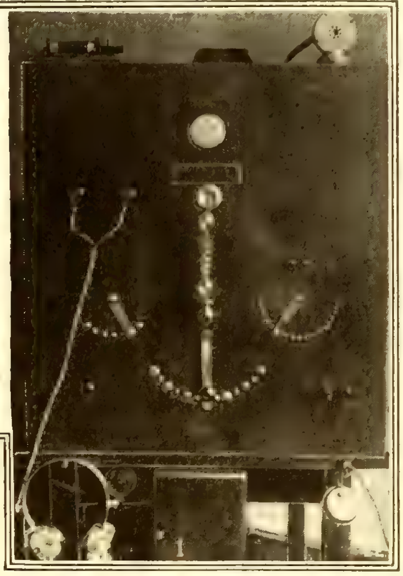
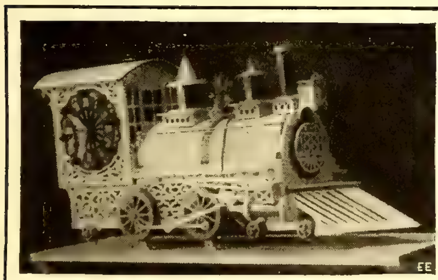


Fig. 1: The Wireless "Revelarophone" Switch-Board Used to Good Advantage in Western Detective Office.
Fig. 2: The Cabinets Here Observed Contain Automatic Voice Recorders as Well as Triple Photographic Apparatus.
Fig. 3: Mr. L. S. May, Chief Electrician of the Secret Service Bureau, in His Private Laboratory.

ELECTRIC CLOCK RESEMBLES LOCOMOTIVE.

A Kansas mechanic has constructed an electric clock in the shape of a locomotive. It is 30 inches long, 13 inches high and 8 inches wide, weighing 9 pounds and 11 ounces. It required nearly eight months to complete this unique model, including the work of wiring and mounting of the thirteen electric lamps. A manual switch controls the wiring system in twelve different ways and combinations. The clock automatically turns on the current at six o'clock in the evening and turns it off twelve hours later. Separate circuits are arranged for the headlight, lamps on the face of the clock and those in the cab. The various lights are flashed on about every fifteen seconds for a duration of three seconds. The dial is of imitation ebony and is studded with tiny ruby and green incandescent lamps. This clock is of the eight-day type and strikes on the hour and half hour by ringing the engine bell. When this is done the driving wheels rotate.

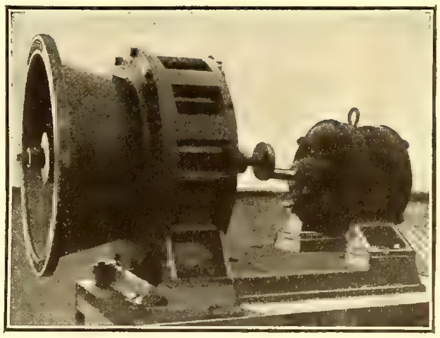


Unique Electric Clock in Form of Locomotive.

Contributed by H. E. ZIMMERMAN.

ELECTRIC SIREN HEARD FOR MILES.

The motor-driven siren of extra large size here illustrated was used as an attraction and also for fog signal work during the recent Panama-Pacific Exposition at San Francisco, Cal. The motor is of the alternating current induction type. The siren or sound producer is direct coupled through an offset crank or coupling. It is said that the one shown here is the largest motor-operated siren ever constructed. It was installed on the roof of one of the Exposition buildings. The piercing and extremely powerful note emitted by this noise producer could be heard ten miles out at sea. This form of electrically operated sound generating device is also available in small and medium sizes which have proven of extreme efficiency for many different requirements such as fog signaling, factory alarms and time signals and the like.



Electric Siren Which Can Be Heard Ten Miles.

WHEN EDISON TAKES LUNCHEON.

The general public is always more or less interested, to an unimaginable degree, in the daily habits and hobbies of those whom the gods have chosen as their most famous sons. The illustration herewith depicts the well-known inventor, Mr. Thomas A. Edison, just finishing luncheon at his home in Llewellyn Park, Orange, N.J. Mr. Edison is a light eater always, but he believes in the best of everything and three meals a day, except when engaged in some lengthy experiments, in which event he frequently forgets to eat for many hours at a stretch.

Talking about habits of "the powers that be," an interesting anecdote is related about Mr. Edison and a box of those justly famous, or rather "infamous," Perfectos with which our wives and sweethearts are wont to bombard us at the Yuletide season. One of his particular friends presented him with a box of what was supposed to be pure Havanas, but which on their first "laboratory test" proved somewhat otherwise. It is said that the cigars were placed on a shelf out of the way, presumably for presentation to some of the many unwanted visitors to the laboratory. Directly, however, the great inventor became so engrossed in deep research work on which he was engaged, that he managed to dispose of every one of those Perfectos. Absent-mindedness is one of the attributes of all the great men it seems, but if some of us didn't concentrate our minds the patent office would go bankrupt.

Photo Copyright by Janet M. Cummings.

Thomas A. Edison, the Veteran Inventor Taking Luncheon at His Home in Llewellyn Park, N. J.

A MOTOR-DRIVEN RIDDLE FOR FOUNDRIES.

A motor-driven gyratory riddle for use in foundries is one of the latest devices designed for boosting efficiency in the great iron and steel plants. It is said that this machine will sift sand faster than one man can shovel it in, and moreover it sifts it better and more thoroughly than can be done by manual labor. Again it is stated that this machine will sift more sand in a day than 10 men. This riddle not only sifts the sand, but mixes it as well, thus saving one turning of the sand. Evenly mixed and tempered sand not only reduces the time of making the mold, but insures a much better mold, necessitating fewer patches after the pattern is made, thus increasing the output of each foundryman, besides making the casting truer to the pattern.

New Motor Driven Riddle for Foundry Work, a Great Time Saver.

The device as here observed may be run about the foundry on a trolley cable. Its motor, being of a small size, may have its service connection plug inserted in any near-by lamp socket. The motor develops 1/6 h.p., and hence is very economical in the use of current. The sieve is 20 inches in diameter, and is held in place by an improved clamping device, which enables the operator to remove the sieve, dump and replace it in less time than it takes to tell about it. The design is very simple indeed, and no gears or other complicated or dangerous moving parts are incorporated. Moreover, there are but three bearings to be oiled and cared for. All parts are made of metal, thus insuring the longest life possible to the device.

NAVY RADIO BRINGS WIFE MONEY FROM HUBBY.

A new application of wireless has been found by the Navy Department. When Mrs. Nellie G. Shippee complained that she was in want, a message was sent from the Brooklyn Navy Yard to the battleship "Wyoming," at target practice off Guantanamo, Cuba, telling Earl W. Shippee, chief electrician, that he must send money to her. Shippee sent his wife a money order.

A MOTROLA FOR YOUR VICTROLA.

The Motrola, as it is called by its sponsors, is nothing more nor less than a very neatly contrived electric motor and driving gear attachable to any type of talking machine for either disc or cylinder records. On the axle of the motor is a worm-gear that operates a wheel and this latter in turn is fastened to the winding rod of the talking machine mechanism.

When connected with the electric current by virtue of the attachment plug supplied with same and inserted in any lamp socket, the Motrola winds up the talking machine to about three-quarters of the capacity of the spring, then the current is automatically cut off. When the machine runs down to about one-half the spring's resistance capacity, the current is automatically turned on again. Thus it is claimed that this device tends to keep the spring of the machine motor constantly wound between one-half and three-quarters of its full strength—which is the strength required to give even time and true tones. One particularly good feature about this attachment is that should the electric current fail at any time, the device may be removed very quickly and the winding crank for the spring motor reattached.

The "Motrola" Electric Motor Drive for Talking Machines.

CHARLES AUGUSTIN COULOMB.

June, 1916, Marks His 180th Birthday. Born, June 14, 1736—Died Aug. 23, 1806.

CHARLES AUGUSTIN COULOMB was born at Angoulême, France, June 14, 1736, and died at Paris, August 23, 1806. Coulomb belonged to a noble family of Montpelier. He chose the profession of military engineering. In 1773 he gained great distinction by his statistical problems applied to architecture, which he presented to the Academy of Science in 1778. He shared with Van Swinden the prize for improvements in the construction of compasses. In 1771 he was stationed permanently at Paris, and was appointed inspector of public instruction in 1802, but he was not strong enough for the work and four years later he died. He had the rank of lieutenant colonel of engineers. His fame rests chiefly on his most elaborate and important investigations in electricity and magnetism, and on his invention of the torsion balance in 1777. This instrument is still used universally in all elaborate research work, particularly in measurements of electrical and magnetic actions. Coulomb proved by a series of extensive experiments, that, contrary to the general accepted theories of Cavendish, electro-static electricity, like gravity, varies inversely as the square of the distance. Adopting the two-fluid hypothesis, Coulomb investigated the distribution of electricity on the surface of bodies. His experiments on the dissipation of electricity are of considerable value. He found that a thread of gum-lac was the most perfect of all insulators; it was ten times better an insulator than a dry silk thread. He ascertained that a silk thread covered with fine sealing wax insulated as effectually as gum-lac, when it had four times its length. Considerable study on his part proved that the dissipation of electricity along insulators was chiefly due to adhering moisture, but in some measure also to a slight conducting power. His writings were collected by the Société de Physique, and a great part of the matter was obtained thru the courtesy of Monsieur Potier from his volume 1 of the "Memoirs Relating to Physics."

The Paris Electrical Congress of 1881 adopted the name of Coulomb as the practical unit of electrical quantity. The coulomb is equal to 10^{-1} of the C.G.S. unit of quantity.

WIRELESS AIDS RAISING OF FUNDS FOR BOYS' CLUBHOUSE.

While a campaign was being recently carried on to raise $125,000 for the erection of a clubhouse, in Charlestown, Mass., wireless played an important rôle. On Sunday, March nineteenth last, at 2 p.m., a radiogram asking help from all amateurs was sent out from the powerful radio station at Tufts College. As a result many amateurs and Boy Scout organizations appeared with contributions which they had collected. The $125,000 was collected in ten days and the club-house will be under construction in a few months. The new club, when completed, will have classes of instruction in wireless telegraphy, wire telegraphy, electricity, engineering, mechanical drawing and many other trades. There will also be a first-class radio sending and receiving station. This organization has twice outgrown its quarters and is forced by lack of space to move to a larger building. At the present time there is a class in wireless telegraphy. Out of twelve boys, eight have passed the Government examination and obtained their license. They all have sending and receiving stations.

Bronze Tablets Mark the Birth-place of the Telephone

March thirteenth last was a red-letter day in the annals of the city of Boston, when

UNVEILING OF THE TABLET ON 5 EXETER PLACE, BOSTON.
In the Foreground are the Following: Vice-president E. K. Hall of the New England Telephone and Telegraph Co., Professor Alexander Graham Bell, Mrs. Bell, Vice-president W. T. A .Fitzgerald of the Boston City Club.

he fortieth birthday of the telephone was celebrated by the Bostonian Society, the Boston City Club and the Telephone Company, assisted by the inventor, Mr. Alexander Graham Bell. Professor Bell was the guest, during his stay in Boston, of the Boston City Club and, accompanied by Mrs. Bell, participated in the unveiling of two bronze tablets placed by the Bostonian Society and the Telephone Company upon the two sites made memorable in the first experiments of Professor Bell.

On a column of a porch of the building, 109 Court Street (now known as the Palace Theater), where, on the top floor, Thomas A. Watson heard the first sound ever sent over a telephone wire, the permanent record "Here the telephone was born June 2, 1875," was placed in bronze. Until Professor Bell unveiled the bronze tablet it was draped and obscured by an American flag.

Professor Bell spoke of his regret over the absence of Mr. Watson (who was in Florida) in his response to the presentation speech by Courtenay Guild of the Bostonian Society and also briefly acknowledged the honor of being present on these auspicious occasions.

A short time elapsed between that unveiling and the arrival of the official party at No. 5 Exeter Place, where, on the wall of the building now occupying the site where Mr. Watson heard the first connected speech over a telephone wire (Professor Bell's "Mr. Watson, Mr. Watson, I want you. Come here"), a bronze tablet was placed, reading "Here Alexander Graham Bell transmitted to Thomas Augustus Watson the first complete and intelligent sentence by telephone, March 10, 1876."

The Bronze Tablet, Commemorating the Birthplace of the Telephone. Erected at 109 Court St., Boston.

Professor Bell, himself, removed the American flag from that tablet, completing the recording of those two historic events.

ELECTRICITY SAVES "BUBBLES" IN BOTTLING CHAMPAGNES.

In the aging and clearing of wines electricity plays a most important part. As may not be generally known, considerable sediment forms in the process of aging wines made from the grape.

In the case of still wines the process can be carried on in casks and the clear wine decanted off, but in the sparkling wines the treatment must be done in bottles. This involved not only considerable skill in handling, but there was often loss of "bubbles."

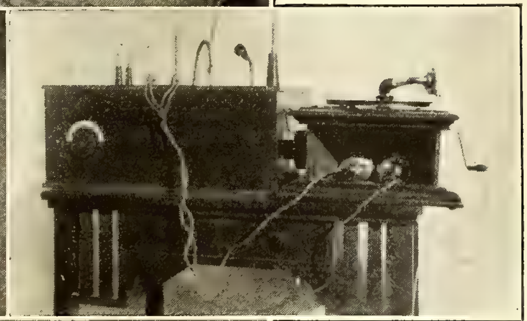
This is now all changed. The bottles are placed in racks neck down and, at various stages of aging, they are transferred to electrical refrigerating machines, which freeze the dense liquid next to the cork. This is then scraped out and the cork replaced. A better product at far less cost is thus secured.

AMONG the hundreds of new devices and appliances published monthly in The Electrical Experimenter, there are several, as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnished to you, free of charge, by addressing our Technical Information Bureau.

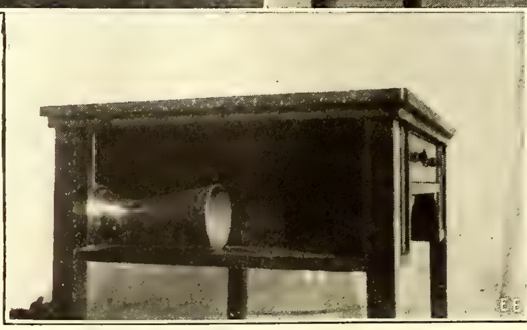
Wireless Music With Your Meals

By ALBERT MARPLE

There is a new "fad" in Southern California, the place where novelties grow over night like the proverbial mushroom. This time the "something new" comes in the form of phonograph concerts by wireless. Sometimes they come in at the noon hour, at others while dinner is being served and again perhaps in the quiet of the evening, while the family is gathered around the hearth. However, when they do occur they do so unannounced, this fact making them all the more welcome. This "music by wireless" idea is one of the most recent electrical inventions of Earl C. Hanson, a young California radio expert. In a word this new "fad" consists of phonograph music being transmitted by wireless from the home of the inventor to the dwellings of a number of friends and neighbors residing within a mile or so of the Hanson residence. This music is sent to all of the homes simultaneously and with no effort on the part of those at the receiving ends of the "line." To show that his invention was a "workable" one young Hanson gave a series of concerts recently and the work of the system was pronounced wonderful.



Left Hand Photo Shows Radiophone Loud Speaking Receptor on Dining Table. Lower Picture Depicts Loud Talking 'Phone on Table.



Top View: Wireless Telephone Enthusiast, Mr. Earl C. Hanson. Right Hand Photo: Victrola, Microphones and Radiophone Transmitting Apparatus.

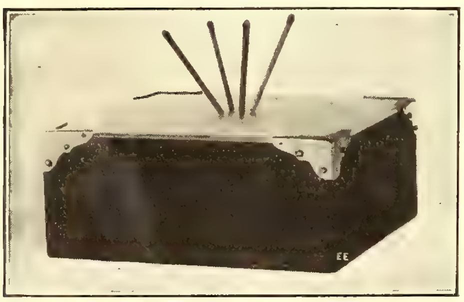
During the past several years Mr. Hanson has been working on a new type of wireless telephone and it is with the assistance of this apparatus which he has recently perfected to a high degree that these wireless concerts are made possible. The telephone shown in one of the illustrations accompanying this story is used as a central station, being located in the experimenting room of the Hanson residence. Upon the roof of his home this inventor has erected an elaborate aerial and this was used for transmitting, while the receiving stations are located, some within and some outside the homes selected for the concerts.

At the central station an ordinary hornless phonograph is placed upon a table along with the wireless telephone apparatus. The shutters at the front of the phonograph are removed and within the "horn" section one or more ordinary microphones are placed, these being connected by wire with a pair of binding posts on the telephone. A cable connects the telephone with the aerial upon the roof. When the phonograph is started the music is caught by the microphones and carried by wire to the wireless telephone instrument, which, after serving as an amplifier continues it on its way to the aerial. After leaving the aerial the sound is caught by the various radio receiving station apparatus, which latter are connected by wire with ordinary telephone receivers, these being equipped with small megaphones, the work of which is to assist in increasing the volume of sound. An important feature about this wireless music transmission is that so far as can be ascertained the music heard at the receiving stations is equally as loud as is that furnished by the phonograph. The central operator has absolute control over the volume of sound furnished by this device, this depending entirely upon the amount of electrical energy employed.

WHAT MAKES THE MATCHES GO AROUND?

A very clever electrical window attraction is shown in the accompanying illustration and is known as the "Mysterious Match Box." The device is much in demand by all merchants, both large and small, having show window space as it can be operated on batteries and does not necessarily require electric light current.

It has been widely used by retail drug stores and has proven very satisfactory as



The Matches Rise, Rotate Then Collapse, Repeatedly.

a business "booster." In operation the matches lie down on the upper plate and at certain moments rise and start to rotate. Directly, however, they collapse again and the action repeats itself periodically, much to the amusement of the wondering public. Any one of a thousand different objects can be made to operate on the piece of glass which forms the top of the cabinet, thereby giving the public something different to think about as frequently as the merchant may desire. A cigar placed flat on top of the glass will rise, whirl in a circle for an instant and return to its original position, repeating this movement continuously.

Possibly the greatest features of all the moving attractions which may be worked with this invention is a display card carrying advertising matter on both sides. When placed flat upon the glass top, it will rise, turn around and then fall back upon the glass again. This operation is kept up continuously in the same way that the matches behaved.

In Zurich, Switzerland, street cars are run by liquid air.

A NOVEL ELECTRIC RUBBING AND POLISHING MACHINE.

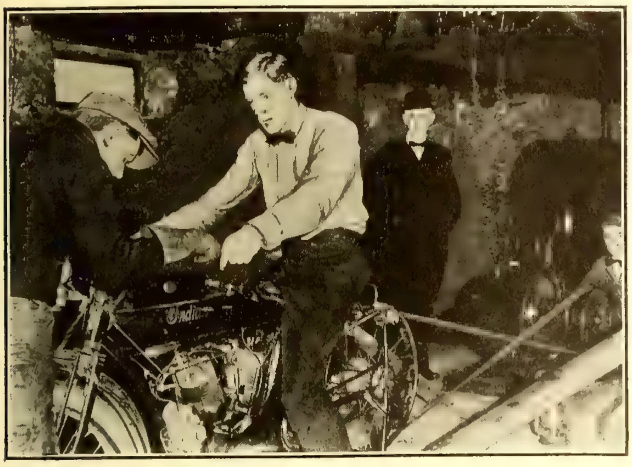
In the accompanying illustration is perceived one of the latest electrically operated grinding, sanding, rubbing and polishing machines adaptable for manufacturing requirements where furniture, stone work and the like are to be dressed, surfaced and polished. The machine operates at very high efficiency and thus costs but a very small amount per hour for its operation. It may be connected up with any lamp socket. The polishing element of the device is driven by a small but sturdy motor, especially designed for the work. The whole device measures 16 inches long, 5½ inches wide and 12 inches high, and weighs 25 pounds. The two felt pads mounted on the face or underside of the machine, each of which measures 5½ by 4½ inches, shift about in an oscillatory fashion over 400 times per minute. A switch is mounted conveniently on the

Unique Electric Polishing Machine.

base of the device to control the motor circuit. Black fiber handles are provided, which eliminate any possibility of the operator receiving a shock.

MOTORCYCLE HELPS LIGHT A TOWN.

When the town of St. Charles, Mo., was left in darkness a short time ago by the breaking of the high-powered transmission cable from the great Keokuk dam on the Mississippi, a motorcycle helped to save the situation in a unique manner and keep the town lighted. Before the town secured current from the Keokuk dam it was illuminated by a steam power plant which drove a 150-kilowatt generator. When the engineers came to hook up the abandoned steam plant they found it possible to get up steam and run the big generator, but discovered at the same time that a very important auxiliary, the little exciter generator, which is run in conjunction with the big machine to excite the fields of same, was out of commission. The sub-station of the Keokuk plant, however, is of the same general type, except that the generators there are driven by motors which take current from the transmission line. The exciter at the sub-station was available, and if power could be obtained to run it the current could be transmitted to the old steam plant and by a combination of the two units the town would be lighted. About that time it occurred to E. F. Wayee, electrician and trouble man employed by the Electric Co. of Missouri, that there was power enough in the engine of his Indian motorcycle if it could be harnessed.



A Motorcycle Used to Drive the Exciter for the Large Dynamos Here Shown Prevented St. Charles, Mo., from Being in Darkness.

No sooner said than done. He set his motorcycle on the stand, took off the tire, slipped on a belt from the rear wheel to the pulley of the little exciter and started his gasolene engine. For an hour and a half he pulled the exciter and furnished the city with light for that period of time, while the wires to the Keokuk dam were repaired. The motor was run on wide-open throttle the entire length of time emergency service was required.

PLANS WIRELESS SERVICE IN MISSISSIPPI.

Frederick de Lamorton who is a wireless operator from the Pacific Coast, whose base of operation has extended as far north as Alaska, and as far south as the Panama Canal, recently spent a few days at his father's home in Laine, Miss., prospective of establishing a wireless station at the port of Pascagoula or Moss Point, for the benefit of the lumber and general shipping interests of that port and the Mississippi Gulf Coast.

The station which is being planned for establishment is to have a radius of 2,500 to 3,000 miles.

ELECTRIC ENGINES PROVE STRONGER THAN STEAM TYPE.

On the Pacific slope of the Rocky Mountains, in sight of Butte, Mont., electricity recently won a decisive victory over steam power. The test was a haul of freight trains up the Continental divide and is said to have been the first practical pulling contest ever arranged to determine the advantage of one power over the other.

One of the trains in the competition weighed 2,200 tons and was drawn by three steam locomotives. The other weighed 3,000 tons and was pulled by a two-unit electric engine. At the time set an electric engine started up the 2 per cent grade, rounded the big curve and sped on at a uniform pace and without apparent effort. A few minutes later the three locomotives came chugging and laboring up the same hill hauling their lighter load.

The contest determined the use of electric engines over the 440 miles of main line from Avery, Idaho, to Harlowton 113 miles of which have already been electrified.

HOW LONG DOES RADIUM LAST?

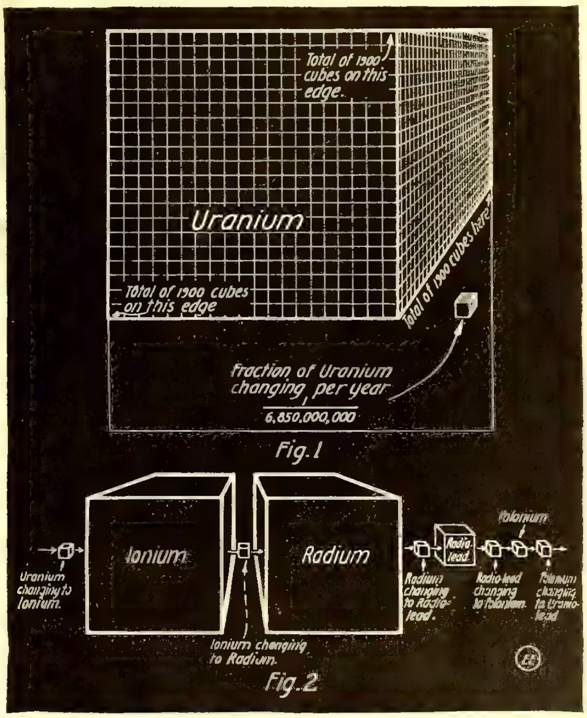
In determining the life of radium, or, in other words, the total time period of deterioration of this remarkable element, it would be quite a simple matter to arrive at the conclusion if radium were formed directly from uranium, thus making it easily possible to separate the radium from a quantity of mineral containing a known amount of radium. The uranium could then be purified so as to be free from all trace of the radium and to allow it to remain until a measurable amount of radium had been produced within it, then to compare the radium so formed from the uranium with the radium present initially in the mineral.

B. B. Boltwood mentions in *Science* that this was attempted, but it was found that radium was produced too slowly to be determined with y accuracy and was far less than was to be expected from theoretical deduction. At any rate, the writer states that this obstacle was overcome in 1907, when he was able to separate from uranium minerals a previously unidentified radio-element which was intermediate between uranium and radium in the series of atomic transformations, and which by its own disintegration produced radium in readily measurable quantities. The name "Ionium" was given to this element. Thus it became possible to separate the ionium element from a mineral containing a known amount of radium and to determine the rate of growth of radium in this ionium. This is a measure of the rate of production of radium in the mineral and therefore a measure of the rate of disintegration of the radium.

The two diagrams (Figs. 1 and 2) will perhaps be useful in making the general conditions and method of procedure more easily understood to those without a technical knowledge of the subject. In the first (Fig. 1) the amount of uranium changing per year relative to the total amount present is shown by two cubes whose volumes are proportional to the number of atoms involved in the transformation. In the second diagram (Fig. 2) the first cube on the left is supposed to be of the same size as the smaller cube in the first figure. Since the constant change of ionium is as yet undetermined, it has been assumed for convenience to be approximately the same as that of radium, and the amount of ionium in the mineral is therefore indicated as of the same order as the amount of radium. With this limitation, and omitting the slight complications involved by the existence of branch products, like actinium, and products of a rapid rate of change, like the emanation and radium-A, the diagrams represent the general conditions and changes to be found in an old uranium mineral.

The chief relation of interest shown by the diagram is that since the radium changing to radio-lead cannot be determined experimentally with sufficient exactness, it is equally satisfactory and very much simpler to determine the ionium changing to radium and compare its quantity with the total amount of radium in the mineral. As a matter of fact, the actual amounts of radium involved in these two quantities need not be known, it is only their relative values which are required, since the value of the disintegration constant is determined by the ratio of one of these to the other. In this respect the method is independent of any standard of purity of radium preparations, an advantage which is not possessed by other methods which have been used for attacking the problem. Thus, for example, the estimate of the half-value period of radium made by Rutherford and Geiger as a result of their experiments in 1908 had to be altered from 1,760 years to 1,699 years when, in 1912, the present international radium standard was adopted.

In some thorough and interesting research work carried on by Miss Gleditsch,



Diagrammatic Representation of Change in Uranium per Year. Also Successive Disintegration of Uranium.

and cited by Mr. Boltwood, there were determined some valuable figures on the probable disintegration period of radium. In four results of experiments carefully conducted the following half-value periods of radium were found, viz., 1,836 years, 1,780 years, 1,640 years, 1,670 years.

Dropping Aerial Bombs Thru a Cone of Light

A NOVEL bomb-dropping scheme is depicted in the painting reproduced on our front cover. This scheme is intended for use in conjunction with Battleplanes, the aerial bombs being dropped through a cone of light. This powerful illuminant is composed of a ring of high candlepower electric lights. Each lamp is supported in a separate reflector under the hood of the bomb-dropper as shown in the accompanying illustration. The various light beams from each lamp cross the other beams and in this manner a concentrated cone of light is produced as is evident. The lamps themselves may be the new incandescent arc units recently developed and perfected by the Ediswan Company of England. This unit has the appearance of a high candlepower tungsten bulb, but instead of heating a fine wire filament in the usual manner, an arc between tungsten or other high fusing alloys is made the source of light.

These incandescent arc lamp units can readily be constructed to yield as high as 3,000 C.P. If then, we should use, say, 20 such lamps (the effiency being 2 C.P. per watt of electrical energy), there would be required 30 K.W. or 40 H.P. with total resultant C.P. of 60,000. The present tendency in building Battleplanes is toward massive proportions, involving engines developing several hundred horsepower. Therefore the energy required for the bomb-dropper illuminant is not unreasonable, and besides it can be built in smaller sizes than here suggested. The energy necessary for operating the electro-magnets which release the bombs one after another (independently but consecutively) is slight and could be supplied by a small storage battery. A dynamo direct-connected to the main engines would probably be found best for the source of current for the high candlepower lamps. Furthermore, there might also be used a form of *cold light*, which, it has been said, a French scientist has quite recently invented.

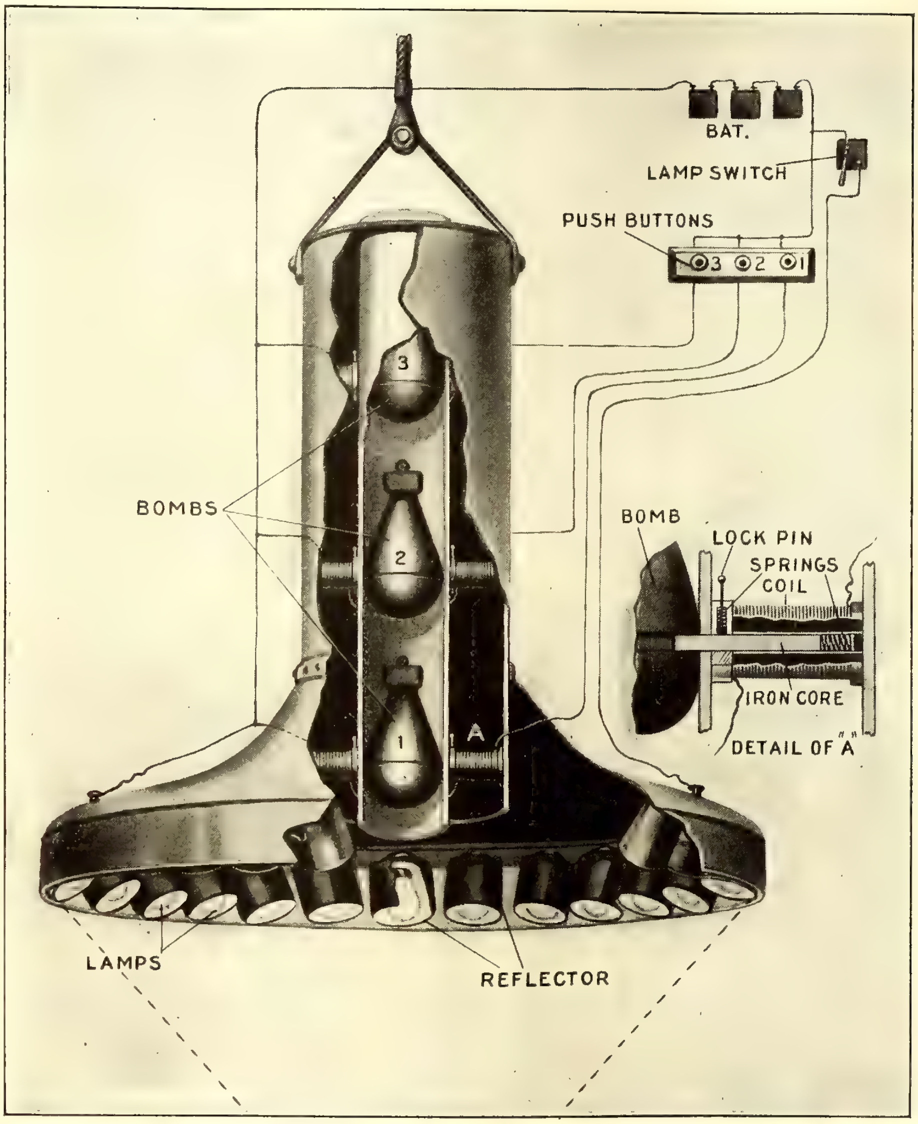
Reports state that the French war office experts are now experimenting with this new type of searchlight proposed by the French professor, Dussaud, which will throw a blinding beam to unheard of altitudes and betray the Zeppelins to the French batteries and aeroplanes.

Professor Dussaud's cold light is generated by utilizing nearly 100 per cent. of the electric current for illuminating instead of losing 70 or 90 per cent. of the power in generating useless heat, as in the ordinary electric lighting system at present.

Hopes are entertained that this system will produce a searchlight five times stronger than the old types, with over 100,000 candle power. These new lights will absolutely blind everything in their path it is said and will bore a luminous hole through the heaviest cloud strata.

At any rate there are a number of powerful electric lamps available for this purpose and by means of a switch on the aeroplane the illumination can be instantly cut off as desired. The bomb-dropper with its ring of lamps is suspended at the lower end of a flexible steel cable and the wires controlling the whole outfit follow this cable also. When necessary the suspension cable is wound up by a power-driven winch and the bomb-dropper can thus be raised right up into the 'plane through a suitable opening in the floor of the machine. It is proposed that the bombs be put up in magazine holders, each of which may contain eight to twelve bombs. It will then be a simple matter to reload the bomb-dropper by inserting one of these prepared magazines, just before the device is again lowered to the proper level.

Referring to the sectional view of the bomb-releasing mechanism, it will be observed that each bomb is retained normally in the vertical magazine tube by a pair of electro-magnets provided with sliding cores. The two cores engage, when projecting within the tube, an annular groove turned in the wall of the bomb. Each pair of magnet coils, corresponding, of course, to a certain bomb, is connected to its own individual push button on a control switchboard aboard the Battleplane. Hence by pressing buttons marked No. 1, No. 2, No. 3, etc., consecutively, the death-dealing missiles will be dispatched earthward with scientific precision and without, moreover, endangering the life of a bomb-dropping expert suspended in a basket at the end of the cable, a scheme said to be employed by the German Zeppelins.



Details of electrically controlled Bomb-Dropper depicted in action on the front cover. A set of electromagnets release each Aerial Bomb at the touch of a button at battleplane commander's side.

In reloading the bomb-dropper the magnetically operated retaining rods are released by simply pulling upward on the locking pins, which are spring actuated as the illustration clearly shows. When the magnet core is pulled inward by exciting, the winding with current from the 'plane above, the locking pin drops into a notch in the core. It cannot move outward again to obstruct the path of the remaining missiles, until the entire mechanism is hauled aboard again. The locking pins can then be manually released, when the bombs are in position, and the springs behind each core will force them outward for the purpose set forth.

This scheme has several distinctive features. For one thing, the dropping of the bomb through a circle of light is bound to increase the accuracy of the marksman, as this arrangement corresponds to a flashlight-pistol which has been proven to possess a deadly accurate fire. Once the target lies in the center of the circle of light, a missed shot becomes a rarity indeed. Identically the same efficiency holds here, modified naturally to some extent, by the movement of the Battleplane in its flight, which makes the work of the aerial gunner considerably more difficult. Should the enemy start shelling the bomb-dropper illuminant, the lamps can be instantly extinguished. Then the armored Battleplane can rise quickly and speed away in safety before the hostile searchlight beams manage to locate it.

By the construction of a dam below Niagara Falls, it is planned to raise the water 90 feet, thus tripling the power now being derived from this great source. This can be done without diverting any water from the crest, which would be likely to mar its beauty.

NEW EDGEWISE ILLUMINATED ELECTRIC SIGN.

What is known as the Polaralite electric sign is shown in the illustration produced herewith. Unique indeed is the method by which the passer-by is attracted by this display. We are all more or less familiar with electric signs, to be sure, where the

The Two Bottles as Well as the Center Plate Light Up in This Sign.

The Two Glass Signs Here Portrayed Are Illuminated by Reflecting Light Through Them Edgewise.

illumination is concentrated either at one or several points. These signs, which, by the way, are works of art, have no highly intrinsic point of illumination perceptible. Instead, the whole sign, which is made of fairly thick glass, is illuminated by a special long tubular incandescent bulb contained in the base of the structure. The light is allowed to filter through the lower edge of the upright glass containing the advertisement. In this way, by having the light rays shoot upward through the glass, a very beautiful and engaging effect is produced. In the sign here illustrated, containing the two bottles at either end, the bottles are illuminated as the sign lights up. In some signs the illumination flashes on or off, but in other cases the light is left on steadily. In either event the effect is beautiful and out of the ordinary.

STOCKHOLM WIRELESS CAN REACH U. S. NOW.

Wireless messages can now be sent from Stockholm to the United States by way of Nauen, Germany, to Sayville, it was announced recently. The messages must be in English and not longer than 25 words, and are sent at the sender's risk.

A FARMER'S AUTOMATIC TELEPHONE.

By Frank C. Perkins.

The accompanying illustration shows a farmer's automatic telephone which is utilized at Aberdeen, S. D., by the Farmers' Automatic Telephone Co. and which, it is claimed, makes possible a simple, practical and economical selective ringing, anti-"rubbering" lockout service for party lines.

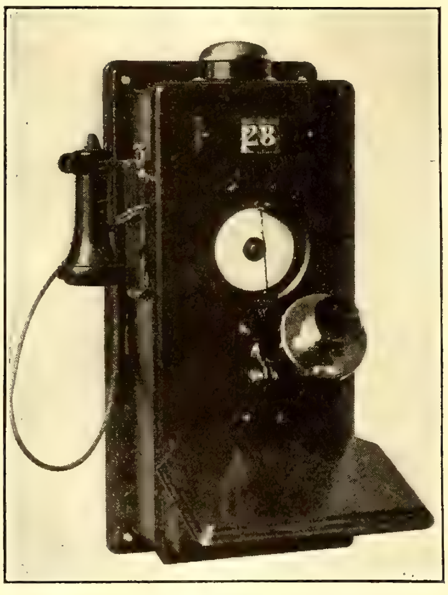
It is pointed out that this mechanism is installed in an ordinary telephone cabinet in place of the magneto generator and consists of a "selector" with numbered dial and an "impulse" mechanism. Twenty-five of these telephones can be on the line and each one can selectively call and be called by any other.

The method of operation is unique. When the line is not in use all the dials stand at zero and receiver hooks are all locked down. When a subscriber desires to call another he first connects his instrument to the line. This is done by inserting the pin in the pin-hole opposite his own number and then bringing it around to the top. When the dial stops moving his bell rings; he now removes the receiver and the hook goes up, making the connection with the line. He then takes the pin and inserts it in the pin-hole opposite the number he wishes to call and brings it to the top. When the dials stop with the selected number at the top the bell of the instrument called rings and its receiver hook unlocks.

It will be seen that the two people may then carry on a conversation without fear of anyone "listening in." If, however, a third party should desire to come in while the line is in use he can do so by bringing his number to the top, ringing his bell and unlocking his receiver hook; but when doing this the two persons already on the line will notice the movement of their dials, and when it stops will know who has come in.

This is preferable to an absolute lockout system which prevents a third party coming in at all, or at the will of a central operator. A central operator cannot always exercise good judgment in handling a line of telephone users of various whims and dispositions. The farmers' automatic set relieves the central operator of this disagreeable duty. Any system which allows a central or the subscribers to absolutely lock out a third party must meet with many serious objections.

It is held that this instrument particularly meets the wants and demands of the farmers for better telephone service.

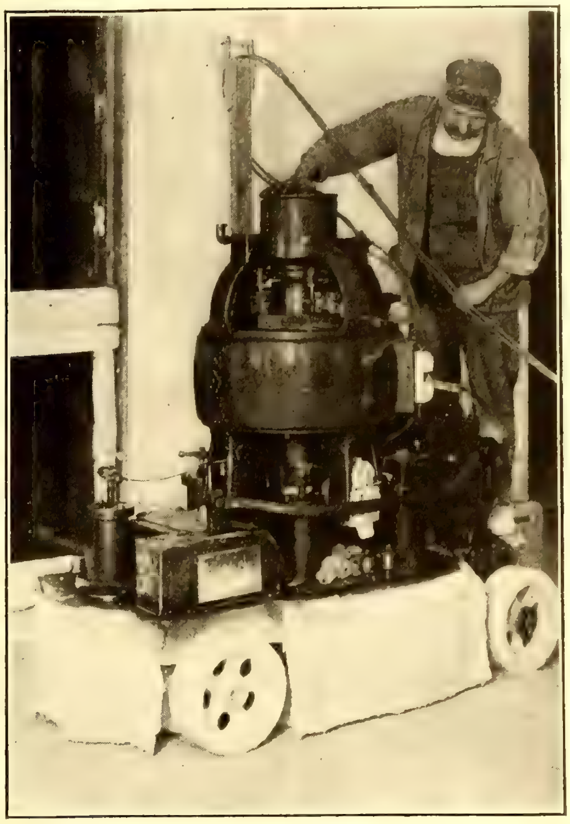


A Selective Calling Automatic Telephone for Farmers' Lines.

The cost of instruments is but little more than that of other telephones, and the cost of maintenance of the line is increased only by the expense of a line battery, or similar means for giving current to the line. The cost of line upkeep is equal to that of a telegraph line of the same length under similar conditions.

POLISHING TILE FLOORS BY MOTOR.

Ordinarily tile floors are invariably put down by artisans skilled in this work, and the paper on which the small pieces of tile



A Powerful Motor-Driven Polisher for Tile Floors.

are pasted is simply washed off. However, when it comes to smoothing and polishing several thousand square feet of such floor surface, it is a man's size job, and the trusty electric motor has been brought into play once more for this particular work. The illustration herewith produced through the courtesy of the New York Edison Co. shows a powerful motor-driven tile floor polishing machine being operated in the new Municipal building in New York City.

The motor on these machines develops 13 h.p. The complete outfit weighs 1½ tons. The motor operates the brush secured to the lower end of the motor shaft at 220 r.p.m. What one of these machines really is capable of accomplishing in a working day is astonishing. That it should work ten times faster than hand operation is not surprising, but, however, what is a more telling fact is that one of these monster polishers does well over 500 square feet per day. For border work a machine of 1-6 h.p. is made use of. Thanks to electrical operation, the contractor with an average force of 75 men was able to accomplish his share of the city's work in a little less than nine months.

ILLINOIS MAY HAVE STATE WIRELESS STATION.

Governor Dunne is considering a plan, it became known recently, to have a powerful wireless apparatus installed at the State House at Springfield, Ill., as a part of the military equipment of the State.

As suggested to the Governor, the plan calls for antennæ reaching from the dome of the State House, 360 feet high, to the roof of the State power plant smokestack, which when completed will be 200 feet high.

Tesla's Early Work With Radio Controlled Vessels

ALTHOUGH present day inventors are prone to shout loudly about their marvelous schemes for controlling torpedoes, boats or other mobile bodies by wireless, it is interesting at this time to take note of the fact that a very complete patent on an ingenious radio control system for torpedoes, etc., was issued to Nikola Tesla in the year 1898, or over eighteen years ago. At that time the science of radio telegraphy was barely on the threshold of possibilities and how far ahead of his time this great scientist is will be the more evident after perusing the following paragraphs:

The illustrations herewith are photographs of the early models constructed by Dr. Tesla and which were actually tried out with entire success. The diagrammatic illustrations will help to explain the working parts of the telemechanical models as outlined in his patent. Fig. 1 shows a model vessel corresponding to that shown in the sectional views, while Fig. 2 represents a model constructed at an earlier date.

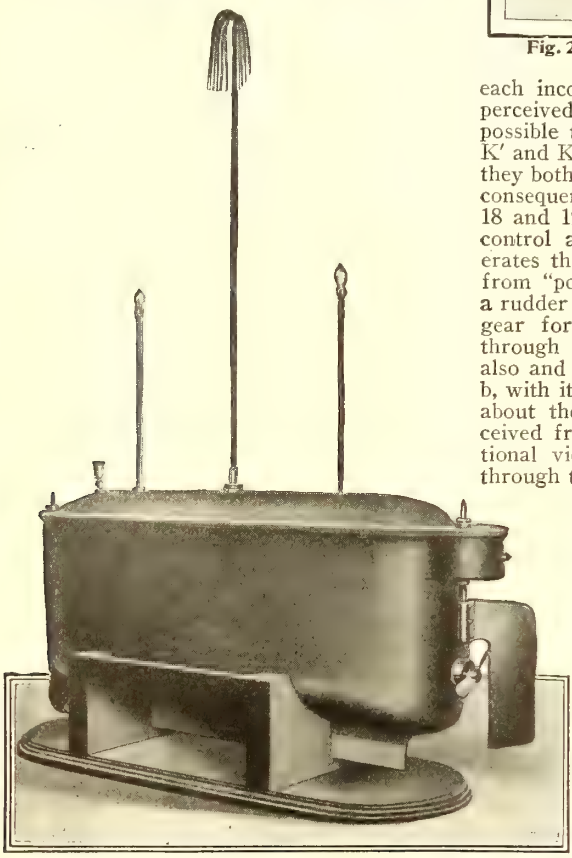


Fig. 1. Tesla's Radio-Controlled Boat Model, Which Was Built Over Eighteen Years Ago.

Fig. 2. Early Model of Radio-Controlled Vessel Designed by Nikola Tesla. It Antedates the Model Shown at Fig. 1.

Referring to diagrams 3, 4, 5 and 6 respectively, we have in general a radio wave sensitive device resembling the well-known coherer at c. This is supported in a special movable holder on the de-cohering or resetting mechanism a and f. The radio receptor circuit connected with the coherer c leads to a grounded connection at B' (see Fig. 4), and an elevated aerial or antenna system E'. A radio transmitting station on shore utilizes a spark gap S, with an elevated aerial and ground circuit hooked-up in the usual manner. A source of high potential current at T is provided to charge the spark gap, thus sending out periodically radio waves of a given frequency. A control switch is mounted on the end of the cabinet at T, and this passes over four points T, T', U, U'. This part of the radio control arrangement will be referred to later.

When an incoming wave passes through the coherer circuit, it causes the relay a and the de-cohering device f to function, and simultaneously a commutator device j' and j'' to rotate a quarter of a revolution for each incoming wave impulse. As will be perceived by referring to Fig. 6, it is thus possible to cause two major control relays K' and K'', to be closed alternately or again they both may be left open-circuited, and in consequence their local or armature circuits 18 and 19 will be left open. These relays control a reversible motor, F, which operates through a worm gear drive to turn from "port" to "starboard," or vice versa, a rudder F'. Referring to Fig. 3, the worm gear for motor F moves the rudder F' through a gear H'', as becomes evident; also and simultaneously the movable sleeve b, with its attached insulated disk L' moves about the fixed vertical rod H. As perceived from the various diagrams and sectional views, this disk L' when rotated through the agency of the steering motor F, will cause a series of metal segments 9, 10, 11, etc., to pass under a set of spring metal brushes 1, 2, 3, 4, etc., which are secured to the fixed insulating member L. The movement of this connector disk controls the circuit of the propelling motor D, connected through a shaft in the usual manner to a screw-propeller C (see Fig. 3). The energy for operating the motor, etc., is obtainable from the storage or other batteries E, carried in the moving vessel.

Tesla in his early patent mentions specifically that the transmitting and receiving radio circuits should be tuned to corresponding wave lengths or at least a harmonic of same. He also mentions that it is possible (although not considered in the present discussion) to control as many as fifty or a hundred circuits, each tuned to a distinct and different transmitting wave length. Of course a different transmitting wave length would be sent out for each control step desired to be put in action at the receiving device in this case.

The coherer of this early vintage is very interesting and comprises a metal cylinder c (detail in Fig. 5), with insulating heads c', through which passes a central metallic rod c''. A small quantity of grains d, of conducting material (such as an oxidized metal) is placed in the cylinder. A metallic strip d', secured to an insulated post d'', bears against the side of the metal cylinder c, forming one part of the circuit. The central rod c'' is connected to the frame of the instrument and so to the other part of the circuit, through the forked metal arm e, the ends of which are fastened with two nuts to the projecting ends of the rod, by which means the cylinder c is supported.

In order to interrupt the flow of battery current, which is started through the action of the sensitive coherer, special means are provided, which are as follows: The armature e' of the relay magnets a, when attracted by the latter, closes a circuit containing a battery b' and magnet f. The armature-lever f' of this magnet is fixed to a rocker-shaft f'', to which is secured an anchor-escapement g. This controls the movements of a spindle g', driven by a clock-train K. The spindle g' has fixed to it a disk g'' provided with four pins b''; hence for each oscillation of the escapement g, the spindle g' is turned through *one-quarter* of a revolution. One of the spindles in the clock-train, as h, is geared so as to make *one-half* of a revolution for each quarter-revolution of spindle g'. The end of the former spindle extends through the side of the frame and carries an eccentric cylinder h', which passes through a slot in a lever h'', pivoted to the side of

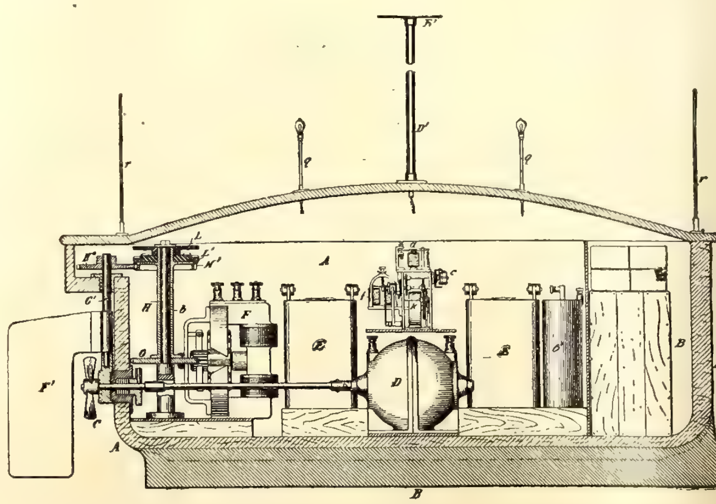


Fig. 3. Sectional View of Telemechanical Vessel Illustrated at Fig. 1.

the frame. The forked arm e, which supports the cylinder c, is pivoted to the end of eccentric h', and the eccentric and said arm are connected by a spiral spring i. Two pins i'i' extend out from the lever h'', and one of these is always in the path of a projection on arm e. They operate to prevent the turning of cylinder c with the spindle h and the eccentric.

It will be evident that a half-revolution of the spindle h will wind up the spring i and at the same time raise or lower the lever h'', and these parts are so arranged that just before the half-revolution of the spindle is completed the pin i', in engagement with projection or stop-pin p, is withdrawn from its path, and the cylinder c, obeying the force of the pring i, *is suddenly turned end for end,* its motion being checked by the other pin i'. The adjustment relatively to armature f' of magnet f is furthermore so made that the pin i' is withdrawn at the moment when the armature has nearly reached its extreme position in its approach toward the magnet—that is, when the lever l, which carries the armature f', almost touches the lower one of the two stops s s (Fig. 5), which limits its motion in both directions.

The normal position of the cylinder c is vertical, and when turned in the manner described, the grains in it are simply shifted from one end to the other; but inasmuch as they always fall through the *same space* and are subjected to the *same agitation* they are caused, after each operation of the relay, to offer precisely the same resistance to the flow of the battery current, until another radio impulse from afar reaches the receiving-circuit.

The relay-magnet a should be of such character as to respond to a very weak current and yet be positive in its action. To insure the retraction of its armature e' after the current has been established through the magnet f and interrupted by the inversion of the sensitive device c, a light rod k is supported in guides on the frame, in position to be lifted by an extension k' of the armature-lever l, and to raise slightly the armature e'. As a feeble current may normally flow through the sensitive device and the relay-magnet a, which would be sufficient to hold though not draw the armature down, it is well to observe this precaution.

The operation of the relay-magnet a, and the consequent operation of the electromagnet f, as above described, are utilized to control the operation of the propelling-engine and the steering apparatus in the following manner: On the spindle g', which carries the escapement-disk g'' (Figs. 4 and 6), is a cylinder j of insulating material, with a conducting plate or head at each end. From these two heads, respectively, contact plates or segments, j' j'' extend on diametrically opposite sides of the cylinder. The plate j'' is in electrical connection with the frame of the instrument through the head from which it extends, while insulated strips J J' bear upon the free end or head of the cylinder and the periphery of the same, respectively. Three terminals are thus provided; one always in connection with plate j', the other always in connection with the plate j'', and the third adapted to rest on the strips j' and j'' in succession, or upon the immediate insulating-spaces, according to which of the four distinct positions the commutator is brought to by the clock-train and the anchor-escapement.

At K' and K'' (Figs. 4 and 6) are two relay-magnets conveniently placed in the rear of the propelling-engine. One terminal of a battery k'' is connected to one end of each of the relay-coils, the opposite terminal to the brush J', and the opposite ends of the relay-coils to the brush J and to the frame of the instrument, respectively. As a consequence of this arrangement either the relay K' or K'' will be energized, as the brush J' bears upon the plate j' or j'', respectively; or both relays will be inactive while the brush J' bears upon an insulating-space between the plates j' and j''. While one relay, as K', is energized its armature closes a circuit through the motor F, which is rotated in a direction to *throw the rudder to port.* On the other hand, when relay K'' is active another circuit through the motor F is closed, which reverses its direction of rotation and shifts the *rudder to starboard.*

A small auxiliary motor, m, may be employed to control signaling lights erected on masts above the deck of the vessel, so that the operator on shore can tell in the dark just how and in what direction the telemechanical vessel is progressing through the water. This signaling motor arrangement is connected in series with the armature of the steering motor F, so that whenever either one of the circuits of the latter is closed through relay K' or K'', the motor m is likewise rotated, but in any case in the *same direction.* The signal lamps may be colored to facilitate matters. By this mechanism it is also possible, by sending out a predetermined series of electric wave impulses, to cause its spring repelled switch arm m'' to come in contact finally with switch point n', thus closing a circuit through a special device o, which might, for instance, be the detonating cap of an explosive chamber in the case of a radio-controlled torpedo.

With regard to the method of handling the entire outfit, we may now have reference to Figs. 4 and 6. Here S designates

(*Continued on page 136*)

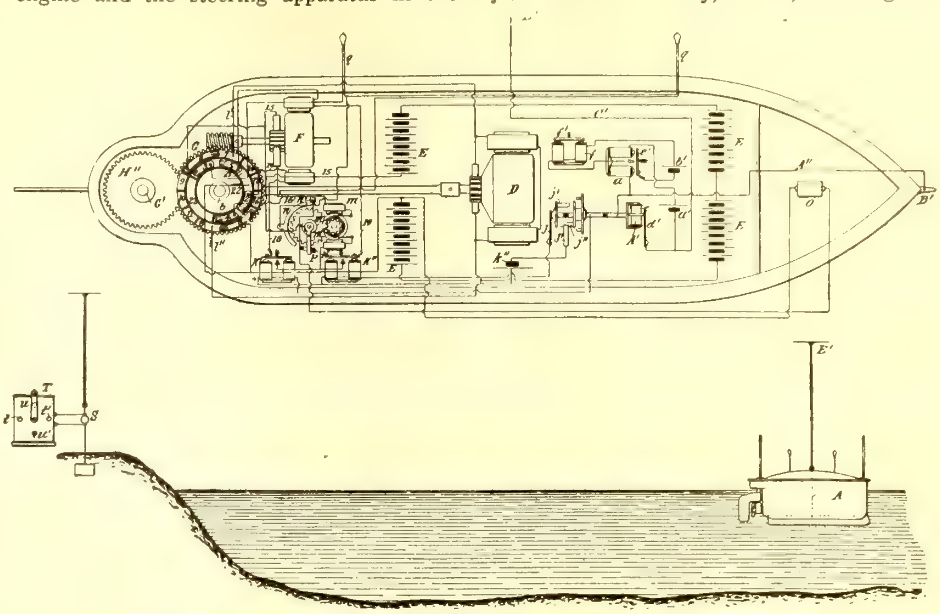


Fig. 4. Plan View of Radio-Controlled Boat and Shore Wireless Station.

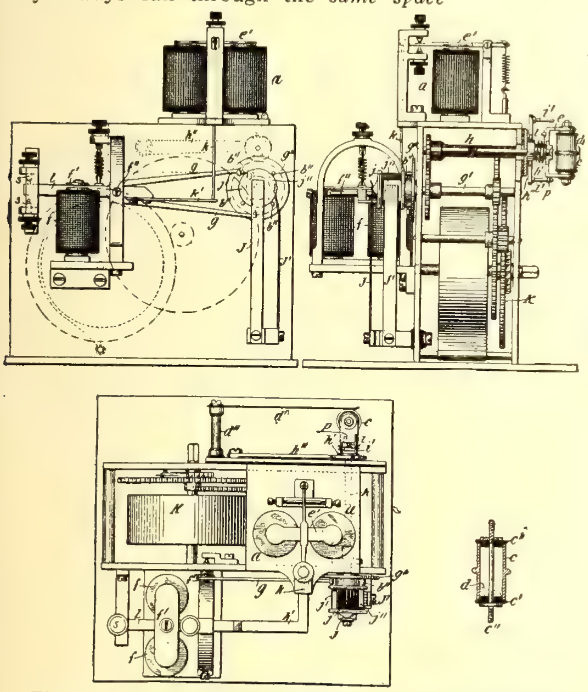


Fig. 5. Details of Clever Coherer, De-coherer and Double Relay Scheme.

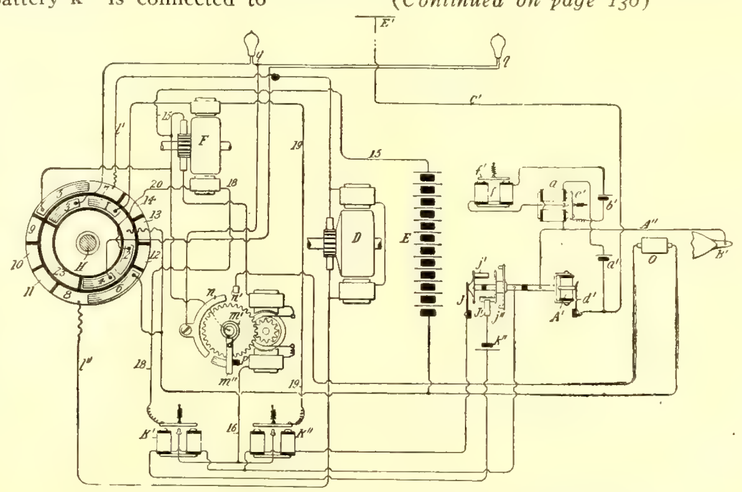


Fig. 6. Circuits of Model Vessel, Including Radio Apparatus.

When Electricity Entered the Home

By Thomas Reed.

PICKING up a magazine, to while the time away as I listen through the receiver for flurries in the wireless world, my eye lights on a double-page advertisement headed "Electricity in the Home," and showing pictures of a hundred fascinating rinktums through which everything in the home can be done for you by the busy and accommodating little ions, except washing the dog and getting Johnny in at supper-time. And as I pore over them, I look back to the old, old days when the only application of Electricity in the Home was the Electric Belt.

The electric belt held the place of honor in the advertising-columns of every paper, from the *Farm and Poultry Oracle* to *Godey's Lady's Book*. Sometimes it was pictured in its habitat around a man's waist (never a lady's; it wasn't considered well-bred then for a lady to appear in the public prints clad only in—er—under-necessaries of any sort); but most often the belt was suspended in air so you could look at the back of it and see the ring of high-tension sparks exuding from each of the copper and zinc discs hidden somewhere inside. It was only in the advertisement that it was so energetic; when you got it home its voltage had dropped perceptibly—dropped so far, in fact, that it could be handled with practically no danger of electrocution.

How slowly new inventions make their way! Volta discovered that zinc-copper-saline-solution thing way back in 1800; and you'd expect him to get a little simple thing like a belt on the market in quite a lot less than seventy years, now wouldn't you? Why, the G. E. Co. would have had one in the 1801 spring catalogue at the latest. But it wasn't till after 1870 that the belt idea really struck in; and then, of course, as usual, the patent had expired, and Volta, too. Regular inventor's luck!

It had to wait for the development of advertising "with a punch"; and the punch in this case was the catch-phrase "Electricity is Life." That was the stuff; what more could you claim for a curative agent and still be conservative? People were getting tired, anyway, of the old-fashioned remedies, like pulverized toads, and then, too, they cost so much; you had to keep buying them and buying them. But this belt was a thing that went right on curing after the first outlay with no expense whatever. Practically one to a family was enough, or even one to a neighborhood, provided the neighborhood was small and conscientious about the weekly bath. It was a great "talking point" in the hard times.

My father used to buy these belts for their curative properties. There was nothing really the matter with father, except that elusive disease known as "what-ails-you," so the belts did him a world of good. The minute you put one on, he said, you could feel the warmth generated by the powerful currents of electricity, as they forced their way through the high resistance of the "organs," on the well-known principle of C-equals-E-over-R. Also, there was a distinct tickling sensation caused by the electricity hunting around over the skin to find the pores. (The belt had four thicknesses of red flannel; but that had practically no influence on its electrical output.)

Father always had two belts on hand—one for a "spare," in case of a breakdown. I cut the "spare" open once to get a diagram of the hook-up. I was disappointed there, because the only hook-up I could find was the strap-and-buckle in the front. The metal discs were sewed to the flannel an inch or so apart (to avoid short-circuiting, I suppose) and that was about all.

In sewing the belt up again, I accidentally left a needle in it. When it went into commission, the needle and father met, and the rendezvous was right over his liver. Perhaps you think he was annoyed? On the contrary, he was immensely pleased. He said it was an unusually powerful belt, best one he ever had. He reckoned that an especially active disc had got mingled with the others. It cured him completely of his liver-trouble and by rotating the belt a little every day, he finally had a completely-cured ring all around him. It did so well that he had a small belt built to treat him for rheumatism in his knee, but that one didn't do him any good. Its wave-length, or decrement, or something, wasn't right; anyhow, it never had the power the needle-belt had.

Electrical apparatus has changed a lot since father's day. Now you can laugh all you want to, but if he could come back I don't believe he would care for the modern rinktums in this advertisement—things that buzz, or boil, or kick when you hitch them to a socket. They can only do one trick per rinktum, and at the end of the month there's a kilowatt-bill staring you in the face. Not like his good old belt, full of discs and mystery and all kinds of powerful "properties" that worked while you slept and didn't dole their benefits out by *meter*. The world has grown better, of course, but prosy—awful prosy.

"Imagination had some play
In the days of old."

"....In sewing father's electric belt up again, I accidentally left a needle in it. Perhaps you think he was annoyed? On the contrary . . . . he said it was an unusually powerful belt; best one he ever had."

JOVIANS AND SOCIETY FOR ELECTRICAL DEVELOPMENT CO-OPERATE.

To effect even closer co-operation between the Jovian Order and the Society for Electrical Development, reigning Jupiter—Thomas A. Wynne, has appointed James M. Wakeman, General Manager; Harry W. Alexander, Director of Publicity, and George W. Hill, of the Field Co-operation staff, as Statesmen-at-Large in the Jovian Order.

The Jovian Order, with its nearly 20,000 members, has substantially the same object as The Society for Electrical Development, but the functions are different. The recent appointment will effect better co-operation which will consistently complement the work of both organizations, such as the founding and fostering of local Jovian Leagues, and the harmonizing of relations between local electrical interests.

The Jovian Order is an effective generator of the personal side of better business conditions in the industry, while the Society will represent, as it does now, more largely the definite business co-operation expressed in a corporate form.

The Jovian Order accepts only personal membership while the Society membership is made up exclusively of firms or businesses.

During the "America's Electrical Week" campaign this fall, it is expected that the Jovians will exert great force in the handling of local sales committee work and celebrations. The Society will, however, conduct the national campaign as it did Electrical Prosperity Week.

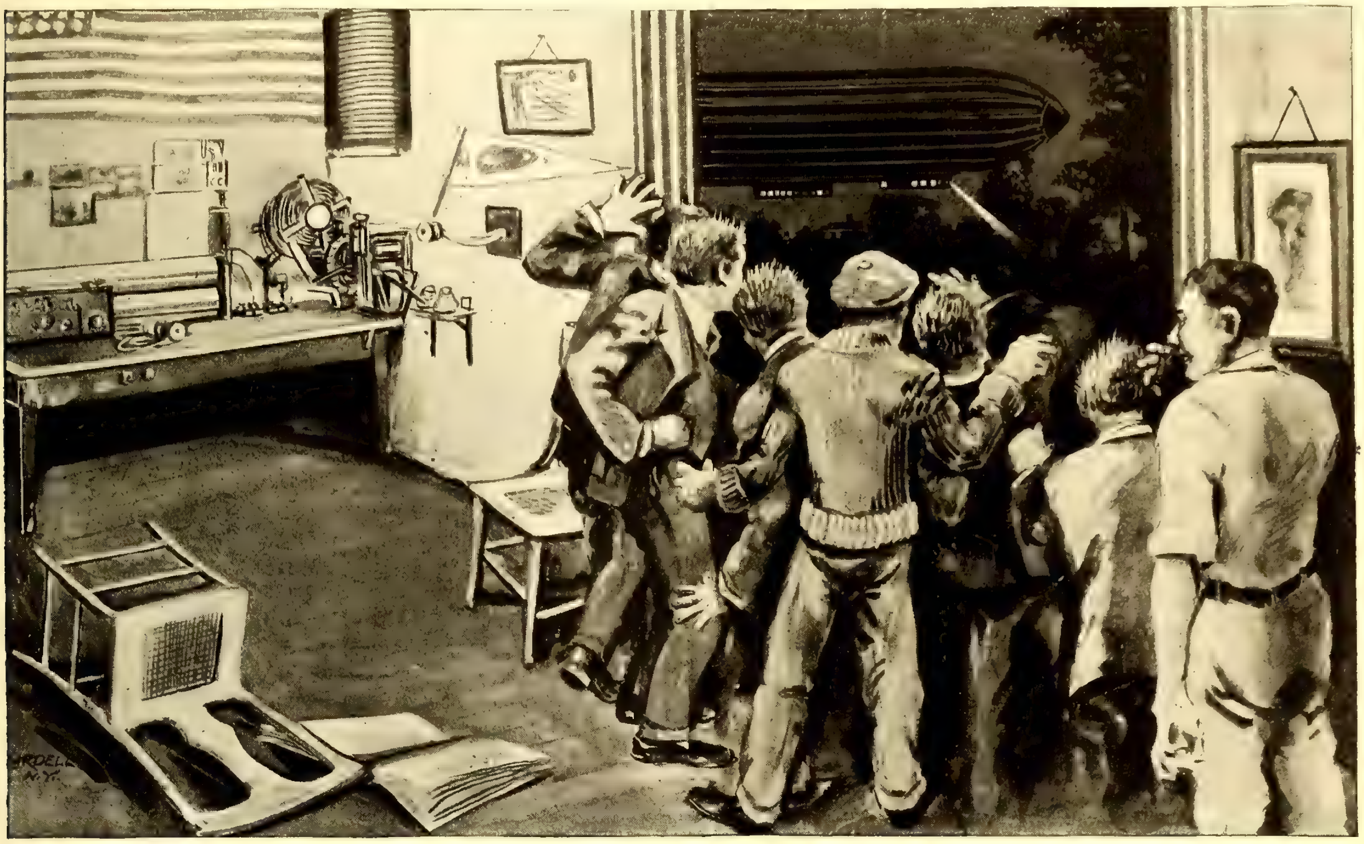
Both the Society and the Jovian Order are growing in membership and the new plans for even more effective co-operation will undoubtedly be great boosts for both organizations.

These societies have done much valuable work in the extension of electric lighting and power service. Both the central stations and the customers have been benefited by their efforts.

The Wireless Wiz Plays War Lord

By Thomas Benson

PERHAPS others may have noticed that an expression will linger in the subconscious mind and any series of sounds will act as a sort of music set to the words. The Wizard's remark to the effect that those who laugh last are not always Englishmen was no exception to this rule.



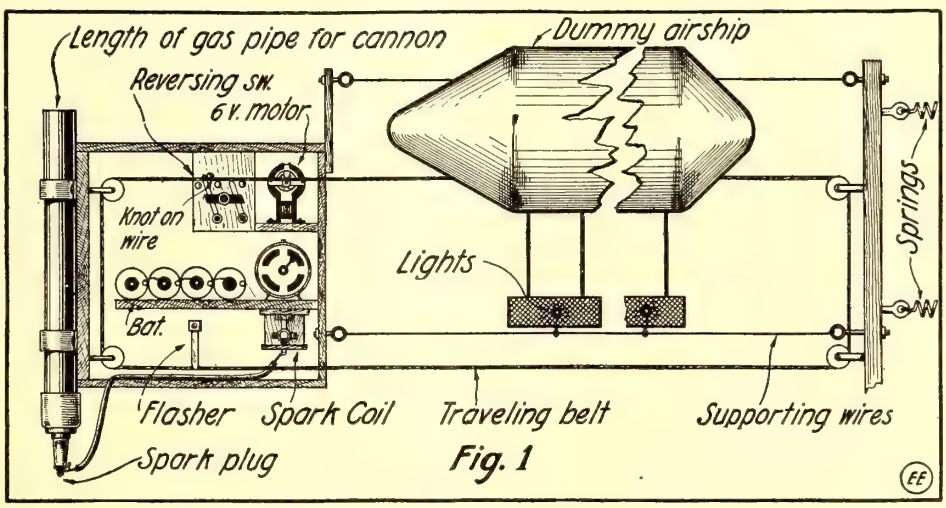
" . . . . . 'Look!' one of the boys gasped, 'there is one of the raiders now.' We rushed to the windows and there, silhouetted against the dark sky, was a massive airship."

The words kept turning over in my mind and every trolley car, even the water dropping from a faulty faucet kept time to the words. Under such conditions a surprise would not be surprising, or putting it the other way, I was expecting the unexpected and naturally he went thru my guard and had his laugh.

The ether had been filled for some time with war talk, the President's latest note, submarine outrages and what not. They had become more than common and no self-respecting amateur would copy the stuff.

Three of the fellows were listening in on my set one evening when we were suddenly electrified so to speak by an extremely loud station sending "Q.S.T." or general call to all stations.

"Some hog on the ether," I muttered, trying to get his exact tune, but his wave was as broad as a housetop without a trace of a peak. "Coming in like a tidal wave, wonder what he has to shoot!" put in some one.



Schematic Arrangement of the Wiz's "Zeppelin" Surprise and How It Worked.

In silence we copied his stuff and looked at each other in amazement. No one wanted to show his "copy," thinking they would be laughed at for mistaking the signals, but an armistice was declared and comparing notes evolved this message:

Q.S.T.—Official reports have it that an air raid is planned on the United States by a foreign nation. The information was obtained by foreign representatives and it is believed that it is too late to prevent the attack. Citizens are advised to remain perfectly calm should their city be attacked and seek shelter at the first sign of danger. Further details are expected shortly.

(Signed) N. A. A.

"Arlington with that wave!" I spoke, half aloud, as the note had not the clear high pitch that usually identified that station. Still they may have tuned coarse and slowed up their gap so that every station would hear it without fail. The puzzle remained unsolved for we could not doubt that the country was in danger of attack despite the arguments of Pacifists to the contrary. That we might ultimately have to fight to hold the money obtained from the nations' cutting each other's throats was an accepted fact but such attacks would surely not be made until the main conflict was settled.

At the next club meeting we mentioned the matter and strange to say no others had copied the signals! The mystery was getting deeper. The penalty for false messages made a trick too dangerous. We were prepared to swear to message and the signature.

At first we were met with incredulity, but our very insistence demanded respect. Our story was told over and over and they had to believe, for even as there is honor among thieves so is there honor among the much maligned radio amateurs.

(*Continued on page 140*)

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

Martian Amusements

PROMPTLY as usual, on the second of 11 p.m., his Excellency "called." Perhaps it would be more correct if I had said hollered, instead of "called." For I have become mighty tired of wearing those Wireless head receivers all of the time, that make you look like a horse with blinkers over his head. A few days ago I installed my new *Audi-Amplifone,* and, in "Bug" language, it is "some peach." Why, if a half-dead wireless waif wave has strayed anywhere within a thousand miles of my station, I will hear it over my Audi-Amplifone as loud as a young brass band in a cemetery at 2 a.m.

I can now sit twenty-five feet away from the horn of the Audi-Amplifone and hear the slightest "rustling" in the ether perfectly plain. No matter how emaciated or how consumptive that wavelet is, I will hear it. It's great, you "Bugs," or my name isn't I. M. Alier!

(P.S.— If the Editor of this sheet wasn't such an insufferable crank, I would tell you right here how I constructed that Audi-Amplifone. Simplicity itself. First, take an old shoe-horn. Then borrow your father's safety razor. Next we need the wheel of a discarded wheelbarrow. Now, try and induce your local boiler factory to loan you a medium-size boiler, about 16 feet high and 9 feet in diameter, which we will need for the horn. After you have soldered the shoe-horn to one of the spokes of the wheelbarrow and riveted the safety razor blade to the closed end of the boiler, we are ready to mount the wheel with the shoe-horn . . . .

NOTE.—*We contracted with Mr. I. M. Alier to furnish us one Münchhausen story a month. So far he has broken his contract twice. We, therefore, cannot allow him, in fairness to other contributors, to run "How-to-Make-It" articles in this department; furthermore our space is limited.*—EDITOR.

(Didn't I tell you that Editor of yours is an unappreciative, soulless old "crab"? —I. M. ALIER.)

Well, anyway, Münchhausen was talking. His dear, croaking, sepulchral voice seemed to fill my wireless laboratory, and I shivered when I tried to realize that his voice had originated sixty million miles away from earth, and here I heard it as plain as if the dear old soul had been sitting five feet away from me instead of talking to me from the Planet Mars.

"My dear Alier," he began, "you are the only human being to whom I can rave about our Martian wonders, and I assure you it is a great relief to do so. It does not help much to voice my constant astonishments to Flitternix, for his brain is in a whirl much the same as mine all of the time. But it *is* a relief to pour out one's heart to someone who is not fortunate enough to have been transported into a civilization hundreds of thousands of years ahead of yours. But alas, I am raving again and you want to hear facts.

"Well, after our host had shown us a close view of the Earth and the planets by means of his extraordinary amplifying 'telescope,' he took us to an after-dinner 'show.' You see certain habits and customs are, after all, much the same on the two planets. Only the 'show' was a bit different than the ones we are accustomed to on earth!

"In one of the superb flyers of the Ruler we flew over the magnificently illuminated city and after a few minutes descended on an immense, slightly curved dome, forming the top of a building. This dome must have measured at least 2,000 feet across and it was constructed out of a single-piece of transparent *Tos.* The dome itself must have been fully 400 feet above the ground. We walked towards the edge of the dome, where at one point a powerful yellow ray was playing at the arena below. Arriving at the source of the ray we peered down into the house, and we involuntarily caught our breaths. What a sight! There must have been at least 200,000 Martians below. And there was no noise, no talk, no sound of any kind! For the Martians do not talk aloud, all conversation being carried on by thought transference. It was uncanny to look at all these thousands of "speechless" Martians.

Before we could find time to think, a peculiar feeling of lightness had permeated us, we were wafted down the yellow beam, as if we had been so many dust particles floating in a sun ray.

"The house was entirely circular, built in the form of an ancient Roman amphitheatre, in other words like a circus. There were twenty distinct tiers, one above the other, with comfortable seats abounding. The arena seemed to be constructed entirely of transparent Tos as far as I could ascertain from the great height at which we were stationed at the time. While we were still marveling, our host had stepped between us and had walked us directly into the yellow ray. Before we could find time to think, a peculiar feeling of lightness had permeated us and we were wafted down the yellow beam, as if we had been so many dust particles floating in a sun ray. Down, down we went at a fair rate of speed, like angels floating in space, 500 or 600 feet, I don't know exactly how much, till we landed on a brilliantly illuminated platform. The second we touched it, the yellow ray was turned off and our original weight was restored to us. He then mounted a few steps and took seats in the luxuriously appointed "box" of the Ruler of the Planet Mars. The seats as well as the upholstery were white and soft, silk-like transparent Tos. The box itself was about forty feet above the arena, and was so placed that we could see nearly every one of the 200,000 Martians assembled in the House. No sooner had the Ruler sat down than every Martian saluted their chief, which they did by merely raising their left hand straight up, pointing it skyward. The hands were kept in this position for a few seconds. The Ruler returned the salute in a like manner for about five seconds. The salutation over, the show began instantly.

"The house was plunged into darkness, when suddenly an immense, dazzlingly illuminated ball appeared over the center of the arena, about twenty feet above the ground, where it hung suspended in space. In a few seconds another, very much smaller, brown ball appeared as if from nowhere. It was some fifty feet distant from the illuminated globe, and it was lighted upon its face by the latter. Another ball, slightly larger than the former, then appeared about twenty feet away from the second globe. Next, still another globe, a little larger than the preceding one, appeared, but this one had a tiny globe of its own accompanying it, but a foot or so distant from the parent one. Suddenly, we understood. *This was a mimic world.* The large illuminated ball represented the Sun. The first small ball was the planet Mercury, the second ball Venus, the third the Earth with its moon.

"In quick succession 'Mars,' with its two tiny moons; then the myriad of small asteroids appeared, followed by a much larger ball—Jupiter, which was larger than all the planets combined, not counting in its many moons. Next came Saturn, with its rings and its moons; then Uranus, and finally Neptune. No sooner had the last planet appeared than all of the planets began to rotate around their 'sun,' a most magnificent spectacle. After revolving for a few minutes, several of the planets slowed down, and finally all stood still.

"Our host explained to us (by thought transference) that these positions of the planets were absolutely accurate for the present time of the year, and that every Martian show opens with the mimic world exhibition, so that all Martians are kept informed of the relative positions of the planets and their respective distances from each other.

"What interested us most, however, was the fact that this mimic world was exactly proportioned, and that the distances between the mimic planets and their sun was also in proportion. By means of anti-gravitational means below the arena, as well as beneath the Tos dome, all exterior attractions and outside planetary gravitational effects were done away with, with the result that the globes hung suspended in space with nothing to make them fall down, exactly as our planetary system, which hangs freely suspended in space.

"Nor was the revolving of the mimic planets around their 'sun' accomplished by artificial means. It is true they were started revolving artificially, by invisible rays, directed from behind the scenes. But once started they kept on their elliptical courses, exactly as the real planets do, in strict accordance with the motion of all bodies suspended in free space. After the mimic planets had reached the desired positions (which their real brothers occupy in space), they were stopped by means of the same invisible rays which started them originally.

YOU are pretty well convinced that intelligent living beings exist on other worlds outside of our earth. It has been accepted for some time that intelligent living beings exist on Mars, that mysterious planet. If intelligent beings they are, what are their habits, how do they think, what are their sorrows, what their pleasures? Are certain human traits only to be found on earth, or has Nature's almighty wisdom seen to it that they prevail throughout the Universe?

Read this interesting instalment, brim full with new ideas; it opens up new possibilities of the capacity of the human mind.

BE SURE TO READ THE JULY NUMBER

The July number of The Electrical Experimenter will be brimming over with good things. Several of the papers previously announced have had to be held over, due to lack of space, but the next issue will make up for the deficiency. Don't miss the July number; here are the reasons:

"Harnessing the Atmosphere's Nitrogen Electrically." By Samuel Cohen.
"The Gyroscope—Its Great Utility." By E. J. Christie, M.Sc.
"Water Wheel Drives For Private Lightin Plants—How to Build Them." By H. Winfield Secor.
"Baron Münchhausen's New Scientific Adventures." By H. Gernsback.
New Tungsten—Molybdenum Alloy Substitute for Platinum.
"The Construction and Use of the Gold Leaf Electroscope." By E. H. Johnson.
"The Mimic Atom"—Part II. By Eric R. Lyon, A. B.
"The Electric Furnace." By Raymond Francis Yates.
Making Selenium Cells.
Popular Misconceptions of Magnetism (Including the Demagnetization of Watches).
Electric Shocks and How to Avoid Them.

"The next act was a beautifully rendered concert by some fifty young male Martians. It was a 'vocal' concert, no instruments being used. Nor did they open their mouths! Still they sang—by thought transference! This, of course, sounds violently impossible. Just the same, I assure you it was the best 'singing' I ever had the pleasure to 'hear.'

"I am equally certain that our lack of experience and training caused us to miss most of the beauty of the concert, for our mental capacity of receiving all of the impulses is of necessity much lower than that of a Martian.

"We probably heard the concert in the same manner as an intelligent monkey hears a Beethoven Symphony. He hears it perfectly—as perfectly as a human being—but he cannot understand its full meaning, because his mind cannot grasp it. Exactly so with us. Our minds were filled with the beautiful music, and while we caught much of the rhythm, the full meaning was necessarily lost upon us.

"The next act was almost entirely lost upon us. From what I could grasp from our host, it was a wonderful symphony of odors. It is well known to you that every smell or odor or scent causes a certain mind reflex or association; thus you are aware of the fact that certain perfumes or scents produce certain emotions upon our nerve centers. Certain scents will immediately conjecture a definite trend of thought upon you, all depending upon the intensity of your feelings. In the present day humans, this faculty of *correctly* associating thoughts with certain scents is as yet but little developed. With the Martian, it seems very highly developed; each scent, every moderation of scent has a certain well defined meaning.

"This is how the 'symphony of scents' was enacted. Perforated pipes were placed on top of the railing of all the tiers. This piping ran continuous through the entire house, while large supply mains led to a mixing and generating plant behind the scenes. The scents and perfumes were led in large mixing chambers, here to be blended scientifically by accomplished artists performing the 'symphony.' By means of pumps the scents were driven into the perforated pipes, but a few feet away from the audience, who thus simultaneously was enveloped into clouds of invisible scents and perfumes. The 'clouds' came at times in puffs, at times they were sustained, sometimes they were long drawn-out, changing from one scent into another. We could detect a certain rhythm throughout, and from the ecstatic expressions on the Martian's faces we understood how deep their feelings were during the performance, which lasted well over half an hour.

"Upon us the full meaning was, of course, lost, for we did not understand it all, but just the same our sensations were delightful in the extreme, and exceedingly pleasant. Just exactly what the feelings of the Martians were, and just what mental pictures or emotions the various scents produced upon their nerve centers, we have, of course, no means of knowing, but we knew that their systems responded very powerfully to the performance.

"The next act was a dazzling acrobatic performance of several Martians, going through marvelous evolutions in free space with no visible means of supporting their bodies. It seems that they were kept float-

(Continued on page 132)

Mimic Atoms and Their Experimental Formation

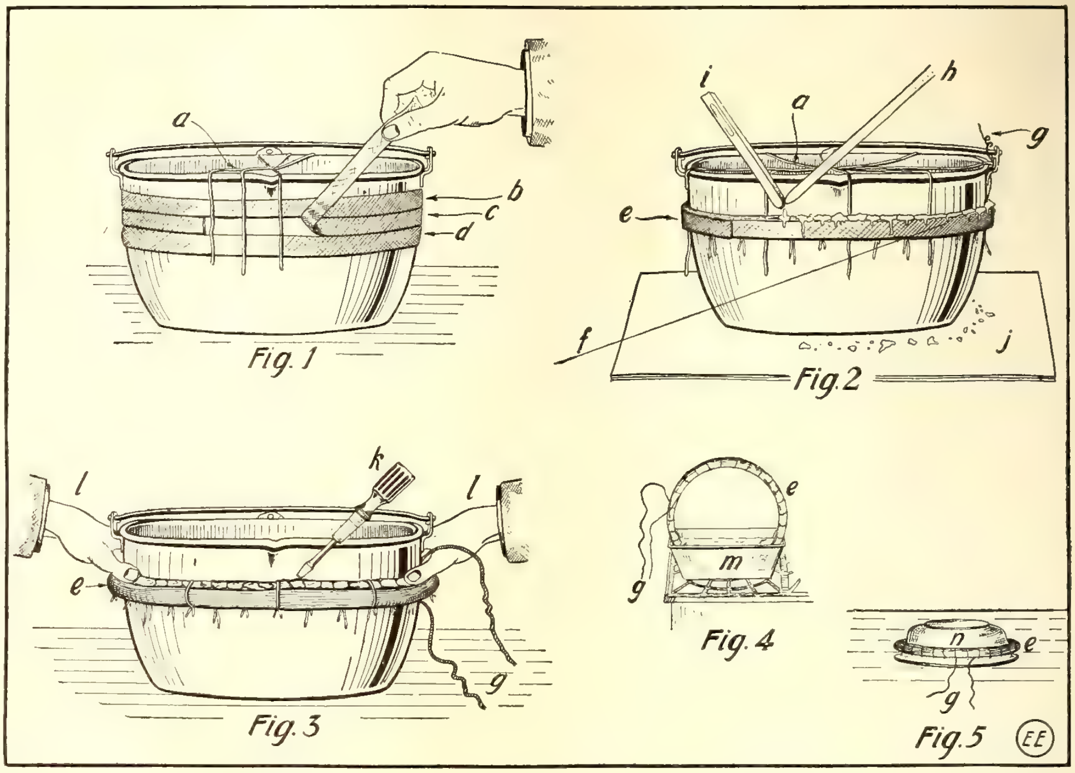
By Eric R. Lyon, A. B.

*[The editors are pleased to state that the subject matter of the original experiments constituting this paper have been discussed before the Physics Club of Chicago University; further that it won a fellowship for its author in the Rice Institute of Houston, Texas; that it was the subject of congratulation to Mr. Lyon upon the part of Dr. A. C. Crehore, of Columbia University, who has, with Sir J. J. Thomson, performed extensive and valuable work toward the establishment of the equilibrium-group-figure theory of the atom. Also commendatory notice was sent the author by Sir J. J. Thomson himself, through the courtesy of the assistant professor of physics in Rice Institute, who met the famous scientist during a visit to England and Cambridge University.]**

Part I.—Experiments.

FORTY years ago saw the real nucleation of a theory which is destined to become one of the greatest contributions ever made to human knowledge. This is the electron theory which sweeps forward to the explanation of matter and to the solution of that question which foreshadows a new age and a marvel era in human progress—the question: "How can we release the almost unthinkably vast energy which is locked up in the atoms?"

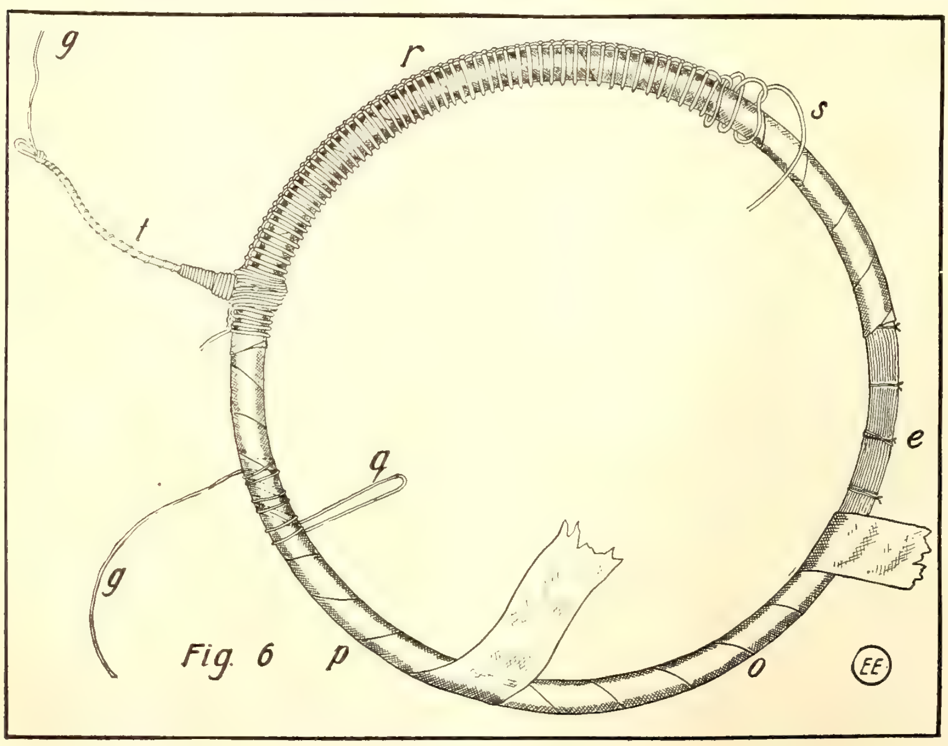
Forty years ago on the eastern side of the Atlantic, attention was first being actively directed toward finding out the nature of cathode rays. There were some who thought these rays were ether waves, similar to radiant light, and others who believed them to be small particles of matter or corpuscles. We all know that the latter were right and that the cathode rays have since been proved to be little flying mites of matter, *the electrons,* which are at once *mites of matter* and at the same time extremely minute *charges of negative electricity.*



Showing the Various Stages Gone Thru in Winding the Submersible Magnet Coil.

Forty years ago on the western side of the Atlantic a work was being done which could not at that time have been seen to have had even the remotest bearing on cathode rays, or upon the only dimly foreshadowed electrons; much less upon the then undreamed of problem of the electronic constitution of the atoms of matter. However, the work was upon the constitution of matter, not in its atoms, but in its crystalline forms as composed of atoms. Prof. Alfred Marshall Mayer of the Stevens Institute of Technology at Hoboken, N.J., was investigating the elasticity of metals. This investigation led him into the study of crystals, because the elasticity of metals is due to their crystalline composition. His study of crystals led him to inquire why the atoms in a crystal (for example, the cube of common salt) should arrange themselves in a regular order or "space-lattice," such that in each group of neighboring atoms the form of the completed crystal may be seen, and such that the latter completed crystal is built up from an original simple group of the type described—wherein an atom occupies and defines each of the several corners or vertices of the crystalline form—simply by the addition of successive parallel layers of atoms to the original crystal faces.

To answer that question Prof. Mayer magnetized a number of sewing-needles, thrust them through corks, and floated them upon a basin of water so that all of their North magnetic poles pointed *upward* and so that all of their South poles pointed *downward.* Having all of their like poles together, the little floating magnets hastened to magnetically push away from one another and to seek the farthest distance apart, which was at the wall of the basin. To counteract this expansion of the group, due to the mutual repulsions of the floating magnets, he held vertically a short distance above the center of the basin a large bar magnet with its south pole down. The south pole of the bar magnet attracted the north poles of the floating magnets so that the group was made more compact and so that the floating magnets were so close to one another that their mutual repulsive



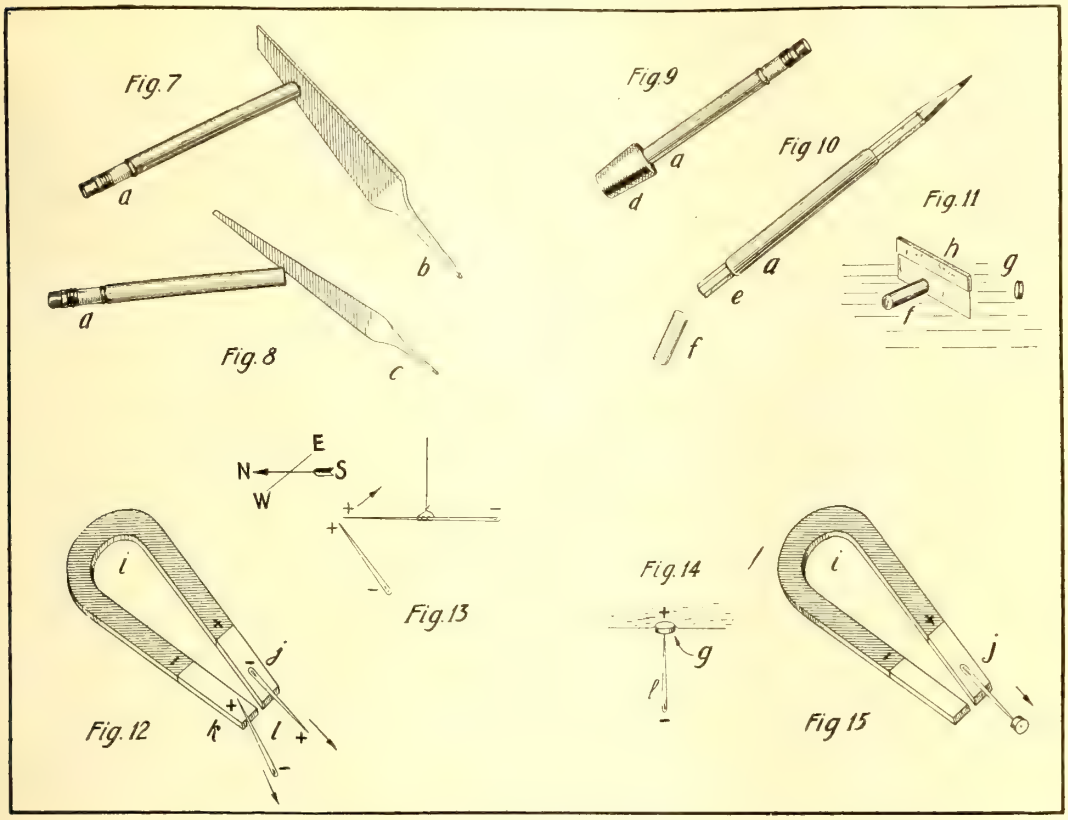
How the Coil, Which Is to Be Submerged in a Tank of Water, is wrapped With Tape and Cord.

* Adapted from the author's paper, "An Extension of Professor Mayer's Experiment With Floating Magnets," published in the "Physical Review," issue of March, 1914. Specially prepared by the author for THE ELECTRICAL EXPERIMENTER.

forces exactly balanced the attraction of the bar magnet. When this had occurred Professor Mayer observed that the floating magnets always arranged themselves geometrically and in concentric rings about a central member, which might consist of one magnet at the center and inside of the innermost ring; or of two magnets, one on either side of that center and equally distant from it; or of three magnets forming a little triangle around the center; or of four magnets forming a little square around that center. The groupings so obtained are practically the same as those shown in Fig. 17 (Part II of this paper). Professor Mayer regarded them as crystals in which the floating magnets take the place of atoms; the mutual magnetic repulsions, of atomic mutual repulsions, or reboundings due to heat quiverings; and the centrally attracting bar magnet takes the place of the force of cohesion which holds the crystal together.

We will not further concern ourselves with this theory of crystallization except to note that the "space-lattice" system of atomic arrangement in a crystal which Mayer sought to explain, has since been proved in form, although not yet explained, by the experiments which have very recently been carried out in the reflection of X-rays from crystal faces.

In the development of the electron theory there was to come the application of Professor Mayer's experiment to the explanation of a much more minute and much more wonderful crystal than Professor Mayer had anticipated. Sir J. J. Thomson in a paper published in the *Philosophical Magazine*, 1904, and in his "Corpuscular Theory of Matter" was the first to give definite statement to this new electronic crystallography of the atom and to employ Mayer's experiment in explanation of an arrangement of the electrons within an atom which must give to the latter the periodic character of its properties and especially of its valencies. It was observed that Mayer's groups (See Fig. 17, Part II,) were periodic in structure; i.e., that a certain form of strcture, say the triangular structure having a small equilateral triangle at the center of the rings' system, would repeat itself after an interval of other kinds of structure, and would be again repeated after another interval of other kinds of structure; each repetition embodying essentially the preceding example of the particular structure, but with the addition of another ring. As we said, periodicity in properties is an extremely important feature in the family of atoms and so Mayer's experiment has come to have a most peculiar significance in the atom theory.



Construction of Cork Disc Cutter and Method of Magnetizing Steel Sewing Needles.

We will now take up the construction of a form of Mayer's apparatus, which is an improvement on the original form, permitting the experimenter to obtain much larger and more beautiful groups than was possible with the use of a suspended bar magnet. Any one will be able to construct this simple apparatus and to actually make for himself the experiments which are possible with it. The construction details may be varied to suit the experimenter's convenience. They are such as were actually followed by the author in making the apparatus described.

The materials to be purchased are:

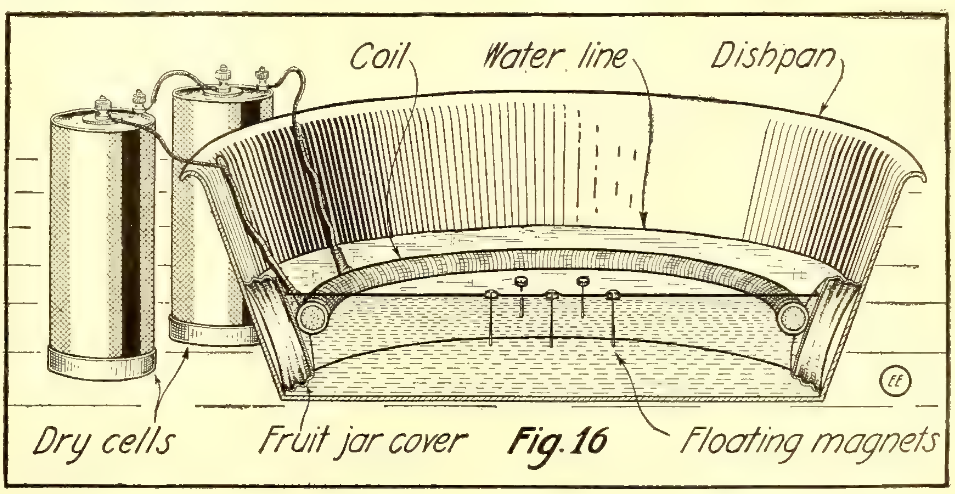
2 dry cells, @ 35c.................. cost, 70c.
1 roll. ¾ in., electrician's black friction tape .... cost, 25c.
1 lb. No. 26 D. C.C. magnet wire .... cost, 70c.
1 small horseshoe magnet (at a 5 and 10c. Store)..cost, 10c.
2 packages No. 10 sewing-needles ("Sharps"), @ 5c. .... cost, 10c.
1 doz. fine grade smooth white, 1 in. corks...... cost, 5c.
1 box "Parowax" paraffin cost, 10c.
2 balls, 1/16 in. wrapping cord or marline, @ 5c.. cost, 10c.
1 stick of sealing wax... cost, 5c.
1 magazine-pencil of the kind consisting of a short brass tube having a removable stub-pencil inserted in one end and a pen and eraser in the other .... cost, 5c.

Totol approx. cost $2.20

Tools and utensils required, but which are kept in any house and kitchen, are a pair of pliers, a screw driver, a stove poker, a good fire of coals in which to heat the poker, a kitchen range or gas stove, a flat file and a triangular file, a safety-razor blade of the "Ever-Ready" type, an ordinary tin (iron) wash basin, a tin (iron) dishpan about 13 in. bottom diameter, 4 fruit jar covers, a bread pan, size, top 10½ in. by 6½ in., depth, 3½ in.; an 8 quart (preferably aluminum) preserving kettle, top diameter, 11¼ in., depth, 6 in.; some cotton cloth or "domestic" to be torn in strips; and some heavy thread, No. 30 linen, or twine.

Fig. 1. Carefully wrap three lengths of tape, b, c, and d, side by side parallel to the top and around the kettle as shown. Strip off the middle length c. Cut twelve pieces of twine, each two feet in length. Arrange these, a, over the top of the kettle so that the ends hang evenly to about six inches down the side of the kettle and so that they are equally spaced around the kettle. Where the twine ends pass over b and d, press them against the sticky surface of b; allow a little slack to fit in c, and press against d. The coil of No. 26 wire will be wound in c and the pieces of twine will be used in binding the coil. Tie heavy wrapping cords around the kettle

(*Continued on page 138*)



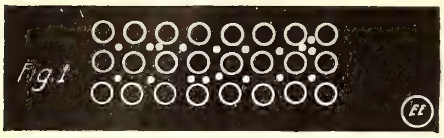
Appearance of Magnet Coil in Tank, Also Batteries and Floating Magnetized Needles.

The Marvels of Modern Physics

By Rogers D. Rusk
Assistant Instructor in Physics, Ohio Wesleyan University

Important Electric Phenomena.

THE simplest electrical phenomena are often the most difficult to explain, and we are apt to take the more common-place of them for granted, without seeking an explanation. For instance we



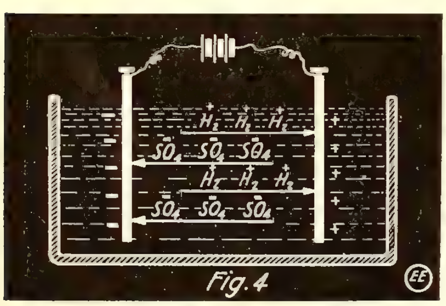
Arrangement of Free Electrons in a Conductor.

are as familiar with electricity flowing in a wire as we are with water in a pipe, but are we as familiar with the *exact nature of the current?* Although the latter is often used to explain the former, in so doing we only draw an analogy which aids us in visualizing the action, and which adds nothing to our knowledge of its nature. In seeking the true solutions of such problems we are brought to a realization of the close relationship existing between different natural phenomena, and we recognize more clearly the fundamental character of electricity.

Electrical phenomena are those occurrences which are caused or brought about by electricity. Of such there are many and their range is indefinite, extending from magnetism and ionization even to that natural phenomena of the polar skies, the aurora.

A battery or dynamo acts as a force pump in forcing an electric current along a conductor. According to the latest theories there may be a number of free electrons in a conductor (Fig. 1), at any given instant, due to the fact that electrons frequently gather sufficient kinetic energy to enable them to break away from their respective molecules. It is a stream of these free electrons that constitutes a current, and we may consider electrical resistance to be due to the friction opposing the motion of these particles. In this theory the existence of the free electrons has been assumed, but their presence can be proved in any metal by heating, and subjection to ultra-violet light. The only drawback is that one is likely to imagine the current as something quite material within the wire. In reality it is more as Steinmetz once said to a surprised newspaper reporter "not in the wire itself but in the ether about it." This is truer than at first seems, for the energy of the current resides in the field of strain about it, and it is this moving field which constitutes the current.

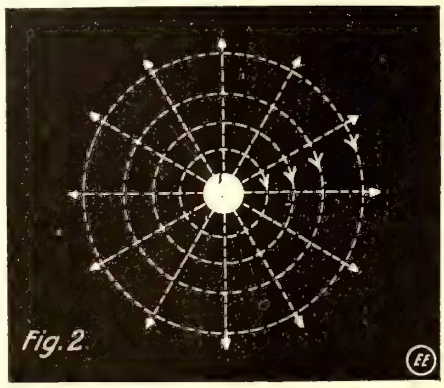
Every moving charge of electricity car-



How Electrolysis Is Possible by the Migration of Minute Electric Charges Between Two Electrodes.

ries with it a double field, as shown in Fig. 2. The straight radial lines represent the *electrostatic field,* while the concentric circles represent the *magnetic field.* Although existing together, they are distinct and at right angles to each other.

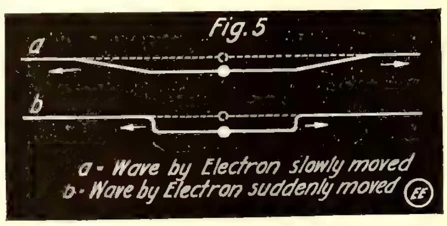
This immediately suggests the close relationship existing between electricity and magnetism, and leads us to conclude that even the electric unit—the *electron*—may produce a magnetic field when in motion. Langevin and Weiss have developed such a theory, which makes every molecule a magnet due to the polarity given it by its rotating electrons. Such an elemental magnet is shown in Fig. 3. In soft iron these elemental magnets are in neutral groups, but when magnetized they arrange themselves with like poles pointing in one direction. In non-magnetic materials, the polarity of the molecules has either been destroyed by opposing electrons or the neutral groups can not be broken up. The fact that the necessary elements are present is proved



Lines of Force About a Moving Electric Charge.

by the well known Heusler alloys which are magnetic alloys formed by the combination of non-magnetic materials.

The passage of a current through a conducting liquid is attended with results quite different than in a solid conductor. In the



Showing Difference between Propagation of Electro Magnetic Wave, by Moving Electron Slowly and Quickly.

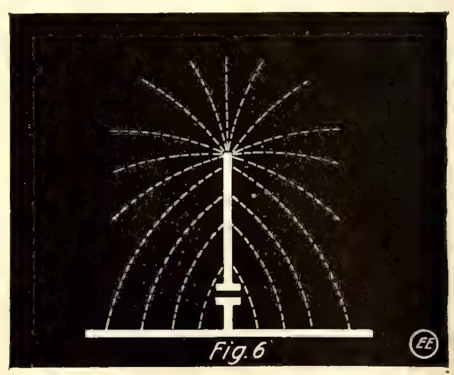
first place, a conducting liquid has striking characteristics of its own. It is ionized; that is, its molecules have divided into charged particles or ions, and these, though neutralizing each other, are free to move about. In the second place an imposed current causes a separation of these charges. Thus, as in the case of sulphuric acid (H_2SO_4) the ions H_2 and SO_4 are formed in solution, which are positive and negative respectively. The current causes a motion of these particles as seen in Fig. 4, and so hydrogen is carried to one pole while the sulphate particles are drawn to the other. The fact that these quantities do not *appear* except at the electrodes suggests that they only exist as true H and SO_4 after having given up their respective charges to the electrodes. This same phenomena of ionization is seen in gases, and thus in matter in all its forms we see evidences of the forces of electricity. In the case of ionization, such a division of the molecules into charged particles has led scientists to believe that electricity is the connecting link between the atoms. This explanation of chemical affinity was proposed some time ago by Davy and Berzelius.

A chemical combination occurs only be-

Illustrating an Elemental Magnet.

tween two atoms each of which contains an unbalanced electron. When the union takes place the excess charge of one fills up the deficiency of the other and a complete neutral molecule is formed. Recently it has been thought that not only those inter-atomic, or chemical forces, but also the inter-molecular forces of cohesion and adhesion may be explained in a similar way. The force of adhesion which makes glue stick to wood, or the force of cohesion which makes the particles of glue stick to each other, are likely an interaction between pairs of electric charges acting through distances which are extremely minute, and depending to a degree on the geometric arrangements of the atoms. A complete theory must wait until our knowledge of the atom is more definite.

More interesting than this to the wireless experimenter is the origin of the electric ether wave. Doubtless many who are familiar with all the apparatus extant have never stopped to think just how these waves are generated. Our present conceptions of light and Hertzian waves are largely due to J. Clerk Maxwell, the mathematical physicist, who suggested that these waves were electro-magnetic disturbances. In order to understand this, let us remember that the *moving electric charge carries a double field with it.* In the case of an alternating current, the electron moves first in one direction and then in the other, or it oscillates back and forth, and the coincident motion of its electric and magnetic fields produces a disturbance of electro-magnetic nature in the ether. This is an electro-magnetic wave. How this wave is propagated may better be shown by taking the example of a single electron and considering only a single line of force. Now if the electron is moved a little to one side as indicated in Fig. 5, the whole line will not all move at



Lines of Force About a Radio Antenna.

once, owing to the inertia it possesses. The part nearest the electron will move first and

(*Continued on page 130*)

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

Manager, H. Gernsback

Radio League of America News

AS evidence of the steady growth of the Radio League of America, the following letter from Captain W. H. G. Bullard, U.S.N., is reproduced, in which acknowledgment is given of the receipt of 596 names of radio amateurs, forwarded by Mr. H. Gernsback, manager of the R. L. of A. In this way the Government authorities in charge of the United States Radio Service are put in touch with all bona fide experimental wireless stations throughout the land. This is of paramount importance in the event of war as many of these amateur stations are capable of handling official radiograms very expeditiously. This fact was forcibly brought out by the admirable work accomplished in relaying a radio message clear across the continent through a chain of amateur stations on the night of February twenty-first last. This remarkable feat was described with photos of the relay stations, in the May number of *The Electrical Experimenter*.

The Rholphakapa Radio Club of East Liberty, Ohio

A great many radio amateurs are under the impression that if the location of their station is once known to Uncle Sam, they are then in a position to be called on for military service if war should come. Such is not the case, however, and although during a state of military rule any amateur station may be confiscated by the Government, the owner thereof is not compelled to operate the station unless he desires to do so. It is gratifying to learn that a large number of those joining the ranks of the *Radio League of America* fraternity are also signifying their willingness to serve their country in time of national peril, by signing the blanks distributed by the R.L. of A. or by the superintendent of Radio Service, Radio, Va.

The letter cited below is worthy of a second reading by all patriotic and law-abiding amateurs. It was sent to the superintendent of Radio Service and has created a profound impression on the officers in charge. Let some of our Radio Club members write also, explaining the scope and facilities of their organizations to Captain Bullard. Following is the Atlanta Radio Club letter. Note the spirit of cooperation manifested therein:

College Park, Ga.

Dear Sir: I would like to give you a few facts about the Atlanta amateurs. As president of the Atlanta Radio Club, it is my duty to see that you do not get a mistaken impression of us.

I have one of the oldest stations in this section and have watched with much interest the increase of the number during the last two years. At first I could hear only one or two amateurs. The number commenced to grow, and soon interference became a problem. By this time most of us knew each other and, being congenial, we decided to band together and discuss our problems.

There were about 10 of us to start with. We secured the use of one of the small anterooms of the Carnegie Library Building and there held our first few meetings. The club grew rapidly. The small room was soon so crowded that we had to seek larger quarters. Several of our number who were members of the local Y.M.C.A. obtained permission to use a large room on the third floor of the 10-story building. We have held our meetings there on alternate Saturday nights since last summer. A temporary aerial has been erected on top of the building and we use it for receiving tests.

After our constitution was drafted we proceeded to draw up a set of operating rules. These rules consisted of the Government Radio Service regulations and a few which dealt with the local conditions. In addition to the usual club officers we elected a club radio inspector, whose duty it is to enforce these regulations. It is also his duty to visit each station once every 60 days for the purpose of suggesting any improvements he thinks necessary.

We decided that the objects of our club should be to promote interest in radio communication and to increase knowledge and operating efficiency. To promote these objects, we have decided to rate each member according to the percentage he makes on competitive examinations to be held every three months. These examinations will be very similar to the Government examinations as given to operators. They will consist of questions on the radio laws and regulations, questions on the theory and operation of the apparatus, and an operating speed test. We believe that by creating a spirit of rivalry among the members the interest will be stimulated and operating efficiency increased.

We want you to understand that Atlanta is as alive "wirelessly" as she is in other respects. During "electrical prosperity week" last December we were invited to enter an exhibit in the electrical show. We realized that this was beyond the scope of the average wireless club, and quite an undertaking for so young an organization. However, after discussing the matter we decided that it would be beneficial both to ourselves and to the public at large. Luckily we were allotted a space right beneath a skylight. Some of our energetic and enterprising members obtained permission, and erected an aerial on top of the 17-story building, on the ground floor of which the show was held. Thus it was that we were able to have a station in actual operation in the exhibit. Several of the boys were always present to explain the mysteries of wireless to the eager spectators. Taken altogether, the venture was a glorious success. The Atlanta newspapers all gave us good writeups and we secured many new members.

The probable reason for the late start of wireless in this vicinity is that there are no Government or commercial stations within 250 miles of Atlanta. In order to hear anything at all the first amateurs had to have comparatively large aerials and very sensitive instruments. Until recently these instruments were beyond the reach of all but the wealthy experimenters. (It is a curious fact that I have noticed that rich amateurs are few and far between.)

As we are so far beyond the zone of interference, most of us use transmitting waves somewhat over the limit prescribed by the Government. We do this knowingly, but we feel that we are still obeying the spirit of the law, which is to prevent interference with Government and commercial stations. If we had the faintest idea that we were

(*Continued on page 132*)

N. S. E 11b

Address Superintendent of Radio Service,
U. S. Naval Radio Station, Radio, Va.,
and refer to No. 13620-17-S

NAVY DEPARTMENT,
U. S. NAVAL RADIO SERVICE,
OFFICE OF THE SUPERINTENDENT.
RADIO, VA., April 21, 1916.

Enclosure

Mr. H. Gernsback, Manager,
Radio League of America,
231 Fulton Street,
New York, N. Y.

My dear Sir:--

I have the pleasure to acknowledge your letter of April 20, 1916, in which you advise that you are sending under separate cover 596 application blanks of members who have been enrolled in the "Radio League of America" since you last wrote on this same subject.

I now have the pleasure of acknowledging receipt of these applications and of thanking you most heartily for them. They will be very valuable in the organization of amateurs in our various districts for Government purposes, independent of the organization of the Radio League and the privileges they have thereunder.

I congratulate you on the growth of the League which is shown by the very great enlargement of its membership, and I assure you your co-operation in this matter is heartily appreciated. I am sure, further, that the Government can find very useful work for these amateurs to do at such times as their services may be needed.

Very truly yours,
W H G Bullard
Captain, U.S.Navy
Superintendent Naval Radio Service.

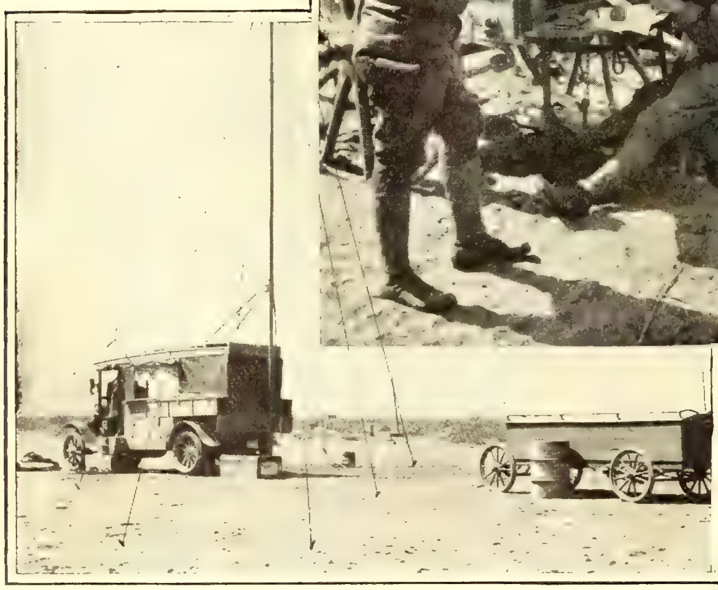
United States Signal Corps Use Radio In Mexico

THE accompanying illustrations depict the excellent portable Radio sets in use by the United States Army Signal Corps during the expeditionary campaign in Mexico. The particular apparatus is that in use at Casas Grandes, Mexico (right hand photo). The Radio operator is receiving Radio messages from the Mexican border line. Many important military despatches are sent back and forth from the expeditionary forces and the army headquarters located on the border.

Owing to the unreliability of the courier and telegraph service, the Radio has proven of wonderful help in maneuvering the various bodies of troops quickly and accurately. Wireless telegraphy has changed to a very large extent the strategy used in the conduct of warfare, both on land and on sea. It is now possible to send a radio call for reinforcements, and to have them on the spot within a few hours in a great many instances, whereas in previous wars it very often required one-half a day or a whole day, and even more, to get a message through.

The illustration at the left portrays the powerful Radio station in use by the United States troops at Columbus, N.M. This outfit is mounted on a large automobile truck and is of sufficient power to serve the army headquarters' staff, even though messages are to be transmitted several hundred miles. The demountable aerial mast rises above the arid, desert-like country to a height of 85 feet. So expert are the signal corps members in unpacking and setting up this apparatus that the whole operation requires but a few minutes.

Most of these radio sets for portable work utilize a gasoline or kerosene oil engine which drives a 500 cycle A. C. Generator. This gives a high pitched spark note which is heard the best in the receivers, especially under tropical and heavy static conditions.



Above: U. S. Radio Operator on Duty at Casas Grandes, Mexico.

Left: Radio Truck and 85 ft. Mast at Columbus, N. M. Note the Sandy Nature of the Country.

PHONOGRAPH CODE-PRACTICE RECORDS THE LATEST.

Wireless telegraphy, especially in England, has become such an important consideration that the British Marconi Company has developed a complete set of records, corresponding to those used on the regular disc type talking machines, each record containing an excellent assortment of code practice in dots and dashes. They were recorded by having an expert operator transmit signals on the specially devised apparatus, while the talking machine was in operation. The present set of records comprise six double-sided disc records, containing instructions for both the beginner and the advanced student. Each side gives from 3 to 4 minutes' instruction at the usual speed at which the record is run; the complete set thus giving up to three-quarters of an hour of first-class receiving practice. This scheme possesses many important advantages over others now in use, and any part of the record is available for instant reproduction, whenever the operator or student may so desire. Moreover, the speed at which the record is run can be controlled to suit any student.

The first record, intended especially for beginners in the art, contains on one side the complete Morse code with all standard abbreviations and punctuation signs. On the reverse side of this record difficult letters such as C, Q, Y, etc., are picked out, and they occur several times in succession; then there follows a sentence very slowly and deliberately, containing several letters of the alphabet. The second disc contains on one side numbers, at a speed in the neighborhood of about ten words per minute, and on the other side, similar matter which has been transmitted at a speed approximately fifty per cent. faster. Owing to the possible regulation of the speed in any standard talking machine, a record whose normal velocity yields 10 words per minute, may be adjusted as to speed so as to give any reproduction at a speed of from 8 to 12 or 13 words per minute.

Both sides of the third record contain dummy messages properly numbered, timed and counted exactly similar to those sent between government or commercial stations and to ships at sea.

Record No. 4 contains stock exchange terms, fractions, etc. On the reverse side of this record is found code words, ciphers, etc., normal transmission being at the rate of 20 words per minute.

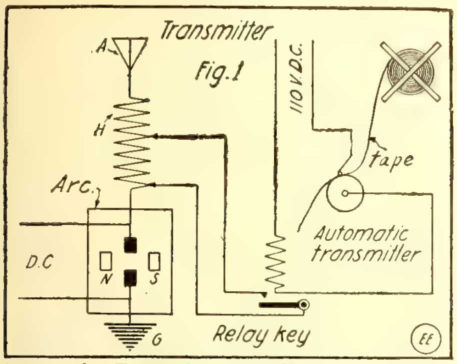
The fifth record contains a collection of messages of varied degrees of difficulty, such as are encountered in the course of an ordinary day's work, and, correspondingly, the speed at which these are transmitted is 25 words per minute. The reverse side of this record contains a miscellaneous assortment of French, Spanish and Italian messages in code, at a rate of 25 words per minute.

The sixth record is perhaps the most interesting of the whole series and without doubt the most valuable. This remarkable record contains signals sent out by two distinctly different transmitters on slightly different notes. The home student who has not had access to a wireless installation will now be in a position to hear just what signals sound like when "jammed" and will at the same time be given exceedingly favorable preparatory instructions for the time when he takes up his duties on board ship. This "jamming" record contains on one side "press," transmitted at a normal speed of 25 words per minute, and "jammed" or interfered with by similar matter transmitted at a slightly lower speed. On the reverse side there is given mixed messages at the rate of 25 words per minute, also "jammed." A student can gain a large amount of practice with this one record, as it often becomes necessary for an operator to read a note through considerable interference of static and one or more neighboring stations which endeavor to deluge him with a multifarious accumulation of dots and dashes, with a few splashes of static thrown in for good measure.

High Speed Radio Telegraphy

By C. V. Logwood

THE first attempt toward perfecting a rapid transmission system for radio telegraphy was that made by the Poulsen Wireless Telephone and Telegraph



Automatic Transmitter for Undamped Wave Station.

Company of San Francisco, California. In June, 1910, the company erected two experimental stations, one at Sacramento and the other at Stockton. These stations were erected for both radio telephone and telegraph work and were especially located at these points so that atmospheric interference would be minimized so far as possible.

The initial high speed radio telegraphic system was installed and supervised by Mr. Schow of Copenhagen, Denmark, with Mr. V. Poulsen as chief engineer. The stations were in charge of Mr. Albertus and Mr. Jensen, both of Denmark.

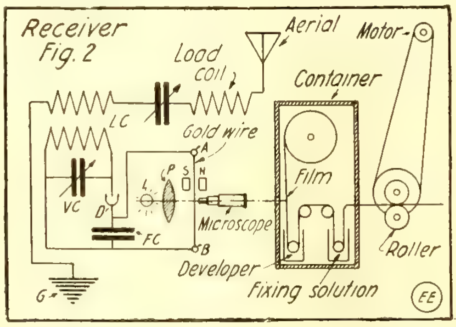
The first system tried out employed a tape transmitter, as shown in Fig. 1. The tape consisted of a perforated sheet of paper containing the (code) message and this was passed between two contacts, one of which was a roller, as perceived. The tape and the two contacts operated a relay, which in turn controlled the antenna wavelength. At the other end the receptor consisted of a standard form of circuit, in which the telephone circuit was linked to a fine gold wire A-B, Fig. 2. This was about four inches long and had a resistance of about 360 ohms. The wire was placed between the poles of a powerful electro-magnet NS, which were excited by 110 volts D.C. A condensing lens P was placed on one side of the gold wire, while in front of it was mounted a Nernst lamp L. The light developed by this lamp was focused on the wire. The light passing through the microscope indicated was caused to fall upon a moving photo film, as depicted at the right. It is then obvious that if the gold wire is made to vibrate it will cause the continuous ray of light to oscillate and thus a wavy image or line will be photographed on the film. The film, which moves continuously, passes through a developing and fixing chamber.

A great deal of experimental work has been conducted on this system, but it finally proved unsuccessful. The first defect that had to be eliminated was that of the breaking of the fine gold wire and the second was that the signals were not clearly recorded on the moving film. This latter was overcome by placing a small slit about 1/32"x½" before the film, so that the light received by it would be equally distributed. The other defect which had to be remedied was that of the detector. The first detector utilized was that having graphite in contact with galena. It is obvious from this description that any direct current impulse through the crystal detector would cause the gold wire to be attracted by the electro-magnet poles.

After extensive trials and research along this line, the experiments proved total failures, but the object was not entirely abandoned. Mr. Christensen of Copenhagen, noting the difficulties which were observed in the previous experiments, began to work on the problem, but after trying for a year without results, he decided to give some other engineer a chance to develop a high speed telegraphic instrument and finally Mr. Elwell, Chief Engineer, assigned the author the task of solving this interesting problem.

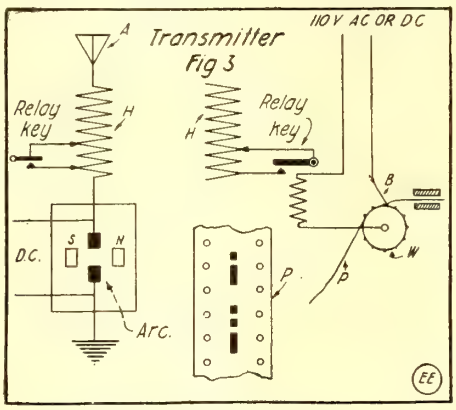
Complete installations were made at Los Angeles and San Francisco, using the last improved type of rapid transmitters and receivers. After six weeks of constant, laborious work it was demonstrated that the system was a complete failure.

The author had previously made some promising experiments with the telegraphone and microphonic relay, which had all the "ear-marks" of a new system. The following scheme was installed by Dr. De Forest and myself. At first a Wheatstone transmitter was employed for translating the perforated paper strip containing the (code) message into dots and dashes. It



Photographic Scheme of Recording Radio Messages.

consisted of a circular, toothed metallic wheel, as perceived at W, Fig. 3, which re-



Perforated Paper Tape Used for Rapid Transmission of Radio Arc Signals.

volved by means of a motor. Upon the surface of the wheel was placed a strip of paper. A fine brush contact B was then placed on top of the paper strip so that it made contact with the metallic wheel W, when a punched mark in the paper was under the brush contact B. The Wheatstone transmitter was connected to the relay, as indicated. Now it is quite evident that whenever the strip of paper traveled across the wheel that it would automatically operate the relay. The first problem encountered in this work was that of finding a proper telegraph relay, which would handle heavy currents at high speed. At last this was overcome by making a powerful, stocky key; one which would act instantly and at the same time withstand heavy amperages.

When the transmitter was finally perfected our minds turned to the development of a receiver which would record the high speed "incoming" signals. The problem was eventually solved by employing a tikker of my rotary type, to break up the sustained waves and then lead them to a three-step audion amplifier; a two-step one of the same type is depicted at Fig. 4. The highly amplified signals were then brought to a single sensitive receiver R. This was arranged against a microphonic transmitter M, the diafram of which was tuned to the receiver's diafram, and thus the greatest amount of sensitiveness was obtained. The microphone was connected in series with a battery and a small telephone induction coil C, Fig. 4, the secondary of which was linked to a telegraphone.

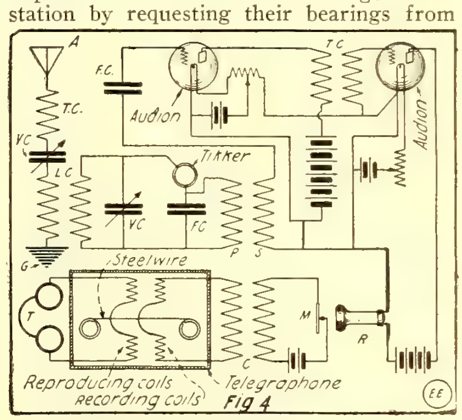
Owing to the coarse sounds produced by the tikker, it was impossible to receive signals having a speed greater than seventy-five words per minute. This was due to the following reasons: the signals coming in at seventy-five words per minute could be readily recorded on the moving steel wire of the telegraphone, but in order to reproduce them at normal (thirty or thirty-five words per minute) speed, it was necessary to run the steel wire slowly and in doing so the tone of the signals was not very clear. This resulted from the harsh sounds developed in the telegraphone receiver due to the slow speed of the moving steel wire. However, this was readily eliminated by employing a higher pitch than the tikker's "paper-tearing" note. The Federal Telegraph Company has operated successfully with this system for a whole season, but signals were transmitted at somewhat slower speed than seventy-five words per minute. Finally it was abandoned as this company installed several duplicate stations.

Apparatus for use in rapid radio transmitters and receivers are still in their infancy and there is a wide field of research for those who are interested in the commercial end of radio telegraphy, as it is patent that a great deal of money can be saved if an all around, thoroughly reliable system can be evolved.

WIRELESS GIVES BEARINGS.

A Bellini Tosi direction finder has been installed at the naval radio station at North Truro on Cape Cod. With it the bearings of a ship from the station can be ascertained by the radio waves and the direction can be found, affording a new aid to navigators in determining their position. In tests the direction finder has been found correct within about two degrees.

All merchant ships with wireless are requested by the Government to aid in the experiments whenever within range of the station by requesting their bearings from



Hook-up for Audion Amplifier and Telegraphone Recorder

the station and stating how such bearings check with the ship's observation.

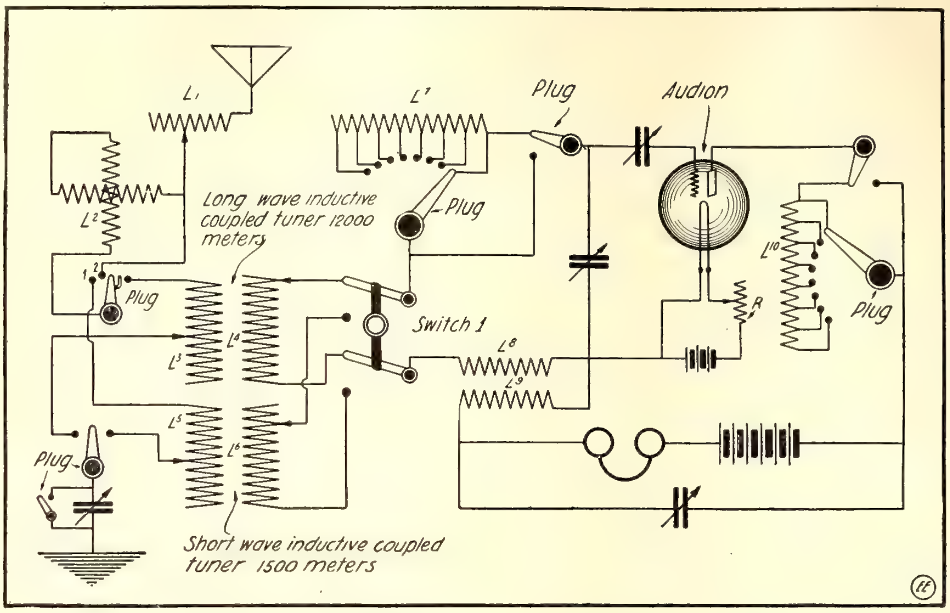
HOOK-UP FOR UNDAMPED AND DAMPED OSCILLATIONS.

With this hook-up the writer has been able to copy Germany, and Honolulu, using an antenna of two wires 165 feet long and 50 feet high.

All contacts for plugs are spaced three inches apart except 1 and 2, which are spaced two inches from each other in order that the variometer may be either cut out of the circuit or left in (for the short wave lengths). The inductance coil L-10 is 28 inches long and 5¾ inches in diameter, wound with No. 28 S.C.C. wire. The coil L-9 is 5½ inches in diameter and 7 inches long, wound with No. 24 S.C.C. wire. The coil L-8 is also 7 inches long and 5 inches in diameter. It is wound with the same wire as coil L-9. Coil L-7 is 29 inches long by 5¾ inches in diameter, wound with No. 28 S.C.C. wire.

The primary winding of L-3 is 6 inches in diameter and 14 inches long, wound with No. 24 S.C.C. wire, and the secondary L-4 is 16 inches long by 5 inches in diameter and wound with No. 28 S.C.C. wire.

When switch No. 1 is thrown to the left and coils L-7 and L-10 cut out of circuit, amateur signals are picked up immediately. It is quite simple with this hook-up to change from the short to the long wave lengths, and moreover, but one audion detector is necessary to gain all the results here enumerated.



Hook-Up for Receiving Either Damped or Undamped Waves with a Single Audion.

Contributed by HARRY Y. HIGGS, R.E.

Our navy needs wireless operators and electricians. The advancement is rapid. All men who enlist for this work are sent to the navy school for six months and are paid while under instruction.

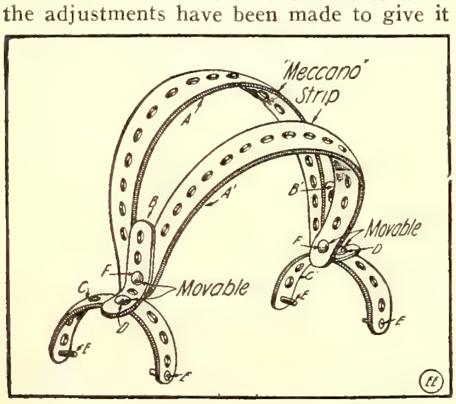
EMERGENCY TELEPHONE HEAD-BAND.

This headband, while easily made, is as serviceable as those which are more elaborate. It is very easy to adjust and can be used in an emergency to good advantage.

A and A' are 12-inch Meccano strips, B and B' are 2½-inch strips and C and C' are 6-inch ones. Bolts and nuts D, E and F are the regular Meccano bolts.

First bend the pieces A and A' as shown. Then bend C and C', also B and B', about ½ inch from the end. Put the pieces together as shown in the illustration. At D and F place a few small washers and clamp two nuts together so as to make these points readily movable. E and E are small bolts filed down to fit the recess in the receiver shell. The whole band may be enameled black or covered with leather after the adjustments have been made to give it a good appearance. To adjust, change the position of F. This headband is of the usual standard type. Contributed by

CECIL H. OSTERMERER.



A "Meccano" Headband for Your Receivers.

POCKET RADIO RECEPTOR WITH 60 MILE RANGE.

This is a real pocket receiving set; one that actually "receives." Using a 50-foot aerial, stations 60 miles distant have been heard, while by using gas pipes, beds, etc., amateurs within two and three miles are easily read.

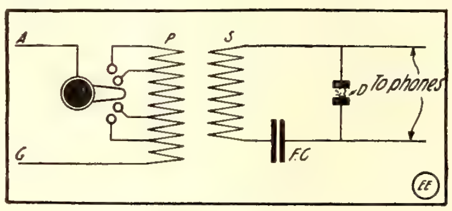


Diagram for Pocket Radio Set.

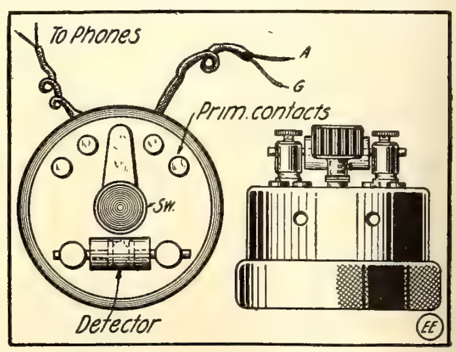
The set consists of loose coupler with taps, condenser, detector and 'phones. The tuning system is all attached inside and outside of an empty wireless receiver from which the magnets have been removed. The loose coupler consists of a primary coil (staggered winding) of 150 turns of No. 30 copper wire wound so as to fit tightly inside the empty receiver. Five taps of 30 turns each are taken off and brought to the midget switch points on the back of the 'phone case. The secondary contains 50 turns of No. 30 wire, with no taps, and fits inside the primary. The condenser fits inside the case also and consists of 36 square inches of tinfoil separated by paper and folded to fit the 'phone.

The detector is novel and consists of a fixed silicon element. That is, a piece of silicon about ¼ inch in diameter is ground flat on two opposite sides and clamped between two rods held by two binding posts. Over the crystal and the rods is placed a cardboard tube. See illustration. Contrary to general opinion, silicon is sensitive and used in this manner is permanent.

Through the two holes in the side of the 'phone two conductor cords are brought. One twin cord connects to the aerial and ground and the other to a head 'phone.

Thus the complete set consists of two 'phones, one containing the tuning apparatus and the other being used over the ear in the usual manner.

First connect all the leads of the coils, taps and condenser. Then put the coils in



Extremely Compact Pocket Radio Receptor.

place and, lastly, the condenser. Screw the cap and diaphragm on to hold the "innards" in place. Wire as per hook-up and connect cords as indicated.

Contributed by EARL H. SWANSON.

A GOOD EMERGENCY AERIAL.

During a recent storm my aerial blew down and on account of the condition of the weather it was impossible for me to go up on the roof and repair it. So I devised the following antenna and was agreeably surprised at the good results obtained.

I had in my cellar four feet of cardboard tubing measuring about four inches in diameter. I wound this with No. 18 bare copper wire (in the same manner as you wind an ordinary tuning coil). Having finished this I lined the bottom with the remains of an old hot water bag. The bottom was lined with the rubber so as not to be grounded when it was inserted over the top of the iron waste pipe, but with a little care this may be dispensed with. After exploring the roof for a suitable place I espied an old waste pipe. After placing the coil over it I connected it to my lead-in and was astonished to hear "Arlington" (NAA) as well as with my regular aerial which was one hundred and ten feet long.

Contributed by

ANDREW W. J. GALLAGHER.

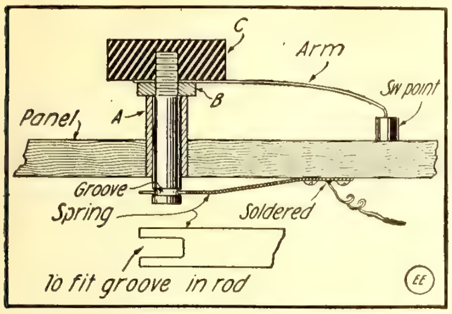
LONG WAVES WITHOUT A LOADING COIL.

Any one possessing a loose-coupler may hear stations whose wave lengths are beyond the normal range of his tuner by connecting the primary and the secondary of the loose-coupler in series, leaving the closed circuit connections unchanged. Of course a certain amount of selectivity is sacrificed by this arrangement, but a loose-coupler connected in this way is more selective than a long wave tuning coil and cheaper than a receiving transformer plus a loading coil. With this connection the writer has been able to bring Wellfleet in very loudly on his receiving transformer.

Contributed by THOMAS T. HOOPER.

A GOOD "TAP" SWITCH ARRANGEMENT.

One of the principal difficulties in constructing a good tuner, switch panel or



Efficient Design of Loose Coupler Switch.

other piece of electrical apparatus requiring a multiple point switch is to mount the knob on the shaft, and the shaft on the panel in a satisfactory manner. The shaft should be rigid and true, and yet turn freely.

The accompanying illustration shows the method evolved by the writer after considerable experiment, and adopted as the most satisfactory, and at the same time exceedingly simple to construct.

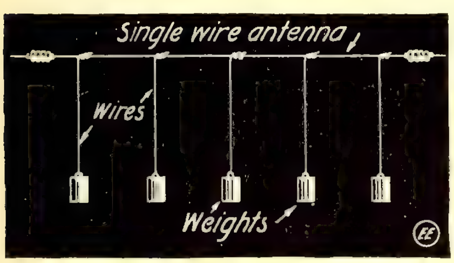
The knob shown at C is best made of Bakelite, hard rubber or black fiber. A hole is drilled nearly through from the under side with a one-quarter inch tap drill, and then tapped as deep as a plug or bottoming tap will go. A thin lock nut is made, as shown at B. A piece of one-quarter inch brass rod is threaded, as indicated, and cut off to the right length, which is determined by the size of the instrument and the taste of the builder. Close to the lower end a groove is turned or filed around the rod for the spring to fit in. This rod is held on the panel by means of the tube A. This may be a piece of three-eighths brass or fiber tubing with a quarter-inch hole, or may be a piece of the same size material with the hole drilled. This tube should be a tight fit for the hole in the panel, and the inside of the hole in the panel should be well soaked with glue before driving in the tube.

The spring, as shown in the insert, has a fork formed on one end to fit the slot, and is bent to pull in on the rod. The spring is fastened to the inside of the panel by screws, as shown, and the connecting wire is best soldered to it.

Contributed by C. S. ROBINSON.

IMPROVING THE SINGLE WIRE AERIAL.

I have found that when using a single wire aerial about two or three hundred feet long, the sending range is increased by suspending as many wires as possible from the single horizontal wire. These vertical



Improving the Single Wire Antenna.

wires may be slid along the horizontal wire by attaching small weights to the ends as shown in the sketch.

Contributed by J. W. HALLIGAN.

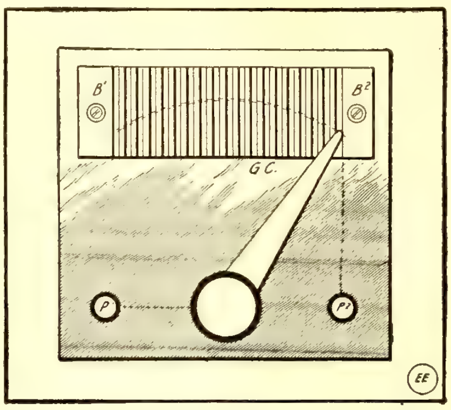
A HIGH-VOLTAGE BATTERY FOR AUDIONS.

The average high-voltage battery for the audion detector or amplifier consists of either flashlight batteries or dry cells.

The battery here described is a good deal cheaper than either of the above and, what is more, most any experimenter can readily make one.

First buy enough raw copper and zinc (any gauge will do) to make between 25 and 60 pieces of both copper and zinc, each 1½ inches by ¾ inch. The same number of sheets of the same size should be made out of common white blotting paper. The base should now be made of fiber, and fiber blocks should be made (B-1 and B-2), so that when fastened with screws near the top of the base the copper, blotter and zinc couples will just fit in between them. The tighter they are the better. The galvanic couples should now be put in place in this order: zinc, blotter, copper; zinc, blotter, copper, and so on until they are all fitted in place. Each couple yields about one volt. The voltage control knob should be mounted at the bottom of the base and a narrow, tapering, knife-edge switch blade attached to same. Five cents' worth of 10 per cent. solution of sulphuric acid should be obtained and applied to the blotters with a medicine dropper. The switch blade should only touch one element at a time.

An interesting experiment may be made by getting your friend to put the wires



Copper-zinc High Voltage Battery for Audions.

from the two binding posts on his tongue and then quickly turning the control switch on. He won't get hurt, but he will be considerably surprised.

Contributed by FRANCIS R. PRAY.

HOW TO FILE COPPER.

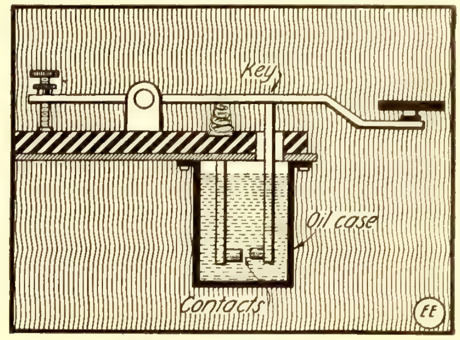
Mechanics are frequently called upon to file copper connections, in wiring switchboards particularly. When using a file on copper the teeth easily become filled or choked, making the file ineffective in a short time. There are two ways of preventing this, says Robert Oster in *Elec. Review and Western Electrician*. One is by using a little chalk on the file teeth; this prevents the copper filings from adhering and choking up the teeth. Another method is to use backward strokes of the file for the finishing touches.

If you expect to keep the wire on your tuning coil tight, place it away from the radiators. Heat stretches the wire.

AN OIL-BREAK KEY.

Herewith is an illustration of a key that is very useful for wireless work, and one that can be used with sets of one kilowatt capacity. When the common wireless key gets red hot at the contact points this can be done away with by having the contacts immersed in oil (paraffin or transil oil).

I hope this may help some amateurs who



Oil-break Radio Key.

are having trouble in keeping good contacts on their keys.

Contributed by JAMES R. ALLEN.

WHAT A SPIRAL AERIAL CAN DO.

Regarding spiral inside aerials, I am sure there are quite a few amateurs who would like to own a receiving set, but hesitate because they do not like to erect an outside aerial, and I am certain that if the following directions are carried out successful reception will be accomplished:

The aerial is composed of about two pounds of No. 14 "Antenium" or other wire stretched along a piece of rope in a coil about 14 inches in diameter and the turns spaced about 3½ or 4 inches apart. The rope is insulated at each end with a porcelain cleat and also supported in the center in the same way.

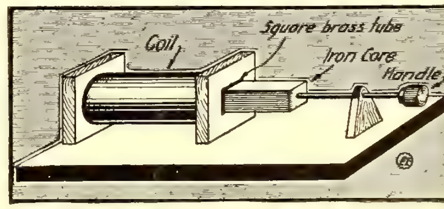
It can be located in the garret of any wood or brick dwelling, provided the roof is not tin and the lead-in wire runs on porcelain knobs to any part of the house; of course running this wire in as straight a line as possible.

The antenna should be at least 25 feet high and 50 feet long. All dimensions given herewith are the same as those used by the author, and with a three slide tuning coil 3,000-ohm head set, fixed condenser, variable condenser, galena detector, and loading coil Arlington can be copied every night during the favorable months of the year, as well as all the commercial and amateur stations in and about Detroit at all times.

Contributed by H. P. HARDESTY.

VARIABLE INDUCTANCE FOR TRANSFORMERS.

The drawing herewith and the description which follows is of a variable inductance to be used in transformer circuits, etc. Wind around a 1-inch square brass tube, 6 inches long, about 100 turns of No. 14 D. C. C. wire. Fasten this to a wood base and then construct a laminated sheet iron core that will slide in and out of the brass tube. The iron laminations may be riveted to form a compact core.



Finely Adjustable "Choker" for Transformer.

This can be done by hand or by means of a screw for fine regulation.

Contributed by CHASE HUTCHINSON.

THE CONSTRUCTOR

A Practical Portable Wireless Set

By Milton B. Sleeper

NOW that summer is in sight, the progressive radio amateur is making ready for experiments with portable equipment. Unfortunately, too many sets are made of extra, or discarded instruments. For this reason, the results which many experimenters have obtained were far from satisfactory. Although it is possible to receive a considerable distance with simply a pair of receivers and a detector, with a large aerial, practical work with portable apparatus requires a set of high efficiency. At the same time, the outfit must be simple, to be compact and easily carried. The set described in this article was designed for use with a single wire aerial, 150 to 200 feet long, 20 feet high at each end. This aerial will not emit a wave of 200 meters, but the spark-coil is so small that it will comply with the law. The complete apparatus, including the battery and carrying-case, weighs only fourteen pounds.

Fig. 1, Appearance of Completed Radio Sending and Receiving Set. Sending Range 3 to 5 Miles. Has Received 300 Miles and is Capable of Much Finer Work.

Sending Set. The general dimensions of the carrying case may vary slightly, but this set is designed for a standard size suit case, the cost of which is only $3.00. Fig. 1 gives a general idea of the appearance of the completed outfit. On the panel at the right are mounted the controls for the receiving instrument and the sending key. In Fig. 2, A is a galena detector; B, B the primary switches; C, the secondary switch; D, the buzzer-test switch; E, the variable condenser, and F, F, the binding posts for two pairs of receivers. As will be explained later, no coupling variation is needed. A buzzer and battery are mounted beneath the panel, Fig. 2. A fixed condenser is fastened inside at the back.

The left hand panel c rries the spark-gap, G, primary circuit ammeter, H, change-over switch, I, antenna and ground connections, J, while the vibrator of the spark coil, K, protrudes into the compartment allowed for the phones. In the case are the batteries and sending condenser. If it is desired, an auxiliary battery may be connected to the binding-posts L.

The wooden frame upon which the panels are fastened, is made of pine or white wood. When this set was built the pieces were cut from one long strip, 4 inches wide and 3/8-inch thick. Fig. 2 gives the length of the pieces.

Although binding-posts are provided at the left of the sending panel, Fig. 1, for the connection of an extra battery, a space is provided in the case sufficient for holding 6 flash-light batterys of 4½ volts each. These when *connected in parallel* have sufficient power to operate the spark-coil for a considerable length of time. It is more satisfactory, however, to carry a separate battery box holding 6 large-size dry cells. The ammeter is to register the current supply in the primary circuit and is always connected in series with the battery and coil. For convenience, the sending key is mounted at the right. It may be necessary to shorten the lever, but this really improves the action of the key.

A code chart, list of abbreviations, or any necessary information can be fastened to the cover. There is room enough to lay a pad of paper on the top when the case is closed.

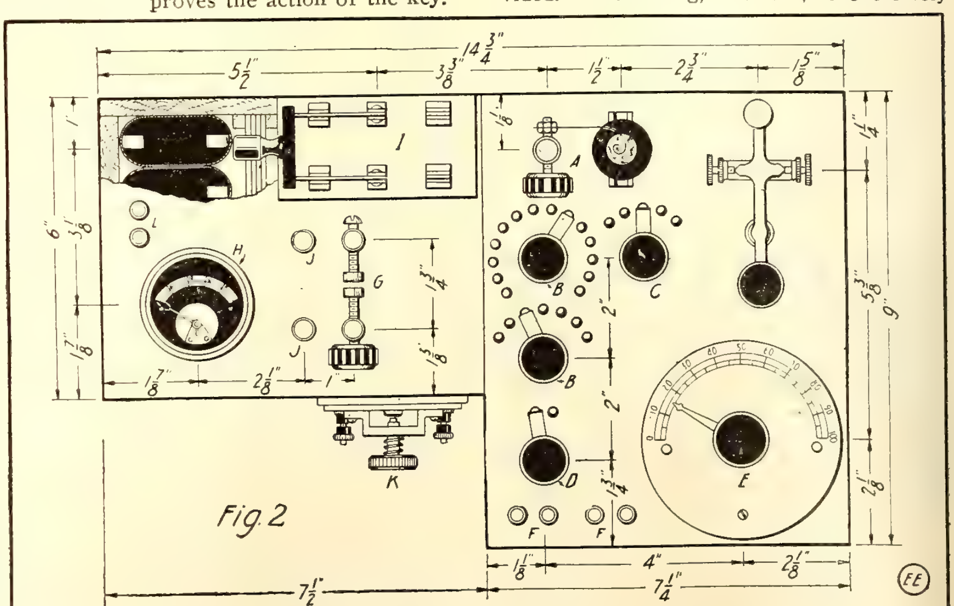
In communicating up to one mile, a half-inch coil is large enough. The coil used with this set is of the *Bull Dog* type. This is most convenient, as the tube enclosing the coil can be inserted through a hole in the wooden case. This leaves the vibrator screw where it can be easily adjusted.

A plate-glass condenser, C, connected in shunt to the coil, Fig. 3, greatly increases the sending range. Four glass plates, 5x3½ inches are needed. The three tin-foil plates are 4x2½ inches. Small wooden strips, ¼x¼ inches hold the condenser in place. It improves the insulating qualities to coat the complete condenser with wax.

The spark-gap, G, is of the conventional type. A thread in the front binding-post makes the adjustment finer than when the movable electrode simply slides in and out. Ordinarily, the gap is not more than 1/32 inch long, as the condenser and the connection of the aerial and ground greatly reduce the usual ½-inch spark developed by the coil.

All wiring, both for the sending and receiving instruments must be of rubber-covered, high-tension cable, to prevent any sparking, due to the small spacing between the wires in the case. A relay, in series with the battery circuit can be used to disconnect the receiving instruments while sending. This requires an anchor gap in the ground lead. A double-pole, double-throw switch, Fig. 1, is more satisfactory, however. A hard rubber auxiliary base was used with this set, although it is not necessary.

Receiving Set. The most unusual part of the receiving apparatus is the loose-coupler. No variation in the coupling is provided. The tuning, however, is extremely



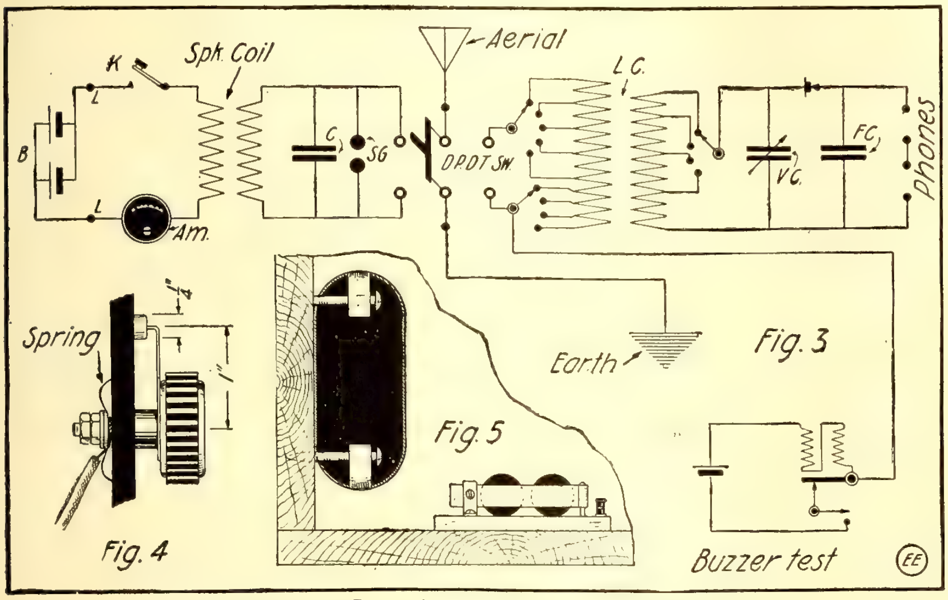
Layout of Sending and Receiving Apparatus to Fit Into Small Suit Case.

sharp, while the signals are much louder than with an ordinary receiving transformer. Unlike most loose-couplers, the primary coil is on the inside. This is composed of a single layer of No. 26 single cotton-covered wire, wound on a tube 5 inches long by 3 inches in diameter. Fourteen taps are taken off, beginning at the left, every fourteen turns. Then seven taps are taken every two turns. All wires go to the inside of the coil, through small holes in the tube. Antenna and ground connections are made to the switch blades.

easily adjusted, and does not jar out quickly.

Some form of fixed condenser, fastened inside the case, must be connected across the receiver binding posts. Connections are provided for two pairs of phones. For only one pair, connections are made to the outside posts.

Fig. 5 shows the buzzer test. A flashlight battery, held by two screws under the spring contacts, supplies current for the buzzer. A high pitch is most easily obtained by gluing a sliver of wood under the contact of the armature The two-point switch controls the buzzer-operation.



Wiring Diagram and Buzzer Test Arrangement in Portable Radio Set

A layer of writing paper or empire cloth, over the primary winding, separates it from the secondary. The same size wire is used for both coils. This may seem unadvisable, if the two circuits are to be brought to resonance. As a matter of fact, the variable condenser in shunt with the secondary makes up for the capacity added to the primary by the antenna. Only five taps are taken from the outer coil; sharp tuning is made possible by the variable capacity. A layer of heavy empire cloth over the coil protects the wire from rubbing against the connections and carrying-case. In the photograph, the upper left-hand switches are for the prim..ry, while the right-hand switch is for the secondary.

Fig. 4 shows a new method of fastening the wires in a simple way, to prevent the connections from being twisted off by the constant turning of the handles. The wire is formed into a loop to fit around t..e shaft. Over this a piece of spring brass, bent in the shape of a bow, is placed. This spring serves the purpose of holding the contact against the switch points, and of protecting the connection. Two washers, under the nuts, make the action smoother. Fig. 2 gives the dimensions for the switches.

A rotary variable condenser gives the close tuning adjustment of the secondary circuit. This is an ordinary 43 plate type, with the case removed. A hole in the hard rubber panel admits the plates; the instrument is held by machine screws from beneath. The tuning is so sharp that a slight variation of the capacity will bring a station in or out.

The detector used with this set is extremely simple, although a.., type can be used. It consists only of an adjusting handle, held in a binding post. At the end of the shaft a fine piece of phosphor bronze wire is clamped by two nuts. The detector cup, holding a piece of *"Radiocite"* rotates in a trough-shaped slide. This detector is

OPERATION.

If a battery is put in the case, it is only necessary to carry, exclusive of the set, two hundred feet of aerial wire and some form of ground connection. An excellent counterpoise consists of ten wires, twenty feet long, fastened together so that they can be extended radia..y. The ground connection is taken from the center. If the set is used on moist earth, however, an iron rod, driven three feet into the ground, will be satisfactory. A reel can be used to hold the two hundred feet of aerial wire and the counterpoise. If possible, the aerial should be stretched between trees; poles are awkward to carry. With a two hundred foot aerial, twenty feet high, the government station at Radia, Va., was easily copied from New York City, a distance of 275 miles. Longer distances, however, can be covered. The one-half inch ... rk coil is large enough to send two miles, or even five to ten miles if an audion detector is used at the other station. The weight of the set, fourteen pounds, makes the set extremely portable. The cost of the entire outfit was only fifteen dollars, low enough to bring it within the reach of every wireless club and Boy Scout troop. Even though the set requires a little careful workmanship, it is far more practical than the little pocket sets, of which experimenters are so fond.

[*Editor's Note: We will be glad to furnish any experimenters or wireless clubs with the names of the manufacturers of the individual or complete apparatus.*]

If you have made any really new apparatus, photograph it and send us a description. It will pay you.

HOW TO REMEMBER OHM'S LAW.

Textbooks state that electromotive force (or volts) designated by the symbol E, divided by resistance (R) equals current in amperes (I); electromotive force divided by current gives the resistance, and resistance multiplied by current shows the electromotive force traversing a circuit. So simple, says R. M. Telschow, in *Telegraph and Telephone Age*, yet so elusive to all students. Science is built around exact formulas and processes, and you can scarcely hope to lay the foundation of a successful career by haphazard methods. So you start all over again, and deepen the furrows made in your fertile brain area by previous efforts.

It may be that the writer is a natural dullard, for these initial principles proved very elusive. Finally, however, the unwilling factors were successfully harnessed, and the trite word "Erie" proved the happy medium.

Henceforth $E \div R = I$, $E \div I = R$ and $R \times I = E$ was simply a matter of mentally looking at the magic word "ERIE." Reading it $E \div R = I$ gave me formula number one; backwards, $E \div I = R$; and forever unforgettable was the multiplication of the central letters R and I whose product was the E on either side of the multiplied factors. Thus, doubt departed forever with the introduction of the "Erie" short cut. Truly a case of "multum in parvo."

EXPERIMENTAL CHEMISTRY.

(*Continued from page 110*)

THE METRIC SYSTEM.

How the table is made up:

Divide a meter into ten equal parts. One of these parts is a DECIMETER.

If a decimeter is divided into ten equal parts, each one of these parts is one CENTIMETER.

If a centimeter is divided into ten equal parts, each one of these parts will represent one MILLIMETER.

Ten METERS make one DEKAMETER.

Ten DEKAMETERS make one HECTOMETER.

Ten HECTOMETERS make one KILOMETER.

Ten KILOMETERS make one MYRIAMETER.

TABLE

10 Millimeters	(m.m.)	(surface)	1 Centimeter	(c. m.)
10 Milligrams	(m. g.)	(weight)	1 Centigram	(c. g.)
10 Milliliters	(m. l.)	(liquid)	1 Centiliter	(c. l.)
10 Centimeters	(c. m.)		1 Decimeter	(d. m.)
10 Centigrams	(c. g.)		1 Decigram	(d. g.)
10 Centiliters	(c. l.)		1 Deciliter	(d. l.)
10 Decimeters	(d. m.)		1 Meter	(M)
10 Decigrams	(d. g.)		1 Gram	(G)
10 Deciliters	(d. l.)		1 Liter	(L)
10 Meters	(M)		1 Dekameter	(D.m.)
10 Grams	(G)		1 Dekagram	(D. g.)
10 Liters	(L)		1 Dekaliter	(D. l.)
10 Dekameters	(D.m.)		1 Hektometer	(H.m.)
10 Dekagrams	(D. g.)		1 Hektogram	(H. g.)
10 Dekaliters	(D. l.)		1 Hektoliter	(H. l.)
10 Hektometers	(H.m.)		1 Kilometer	(K.m)
10 Hektograms	(H. g.)		1 Kilogram	(K. g.)
10 Hektoliters	(H. l.)		1 Kiloliter	(K. l.)
10 Kilometers	(K.m.)		1 Myriameter	(M.m.)
10 Kilograms	(K. g.)		1 Myriagram	(M. g.)
10 Kiloliters	(K. l.)		1 Myrialiter	(M. l.)

USEFUL METRIC TABLES

1 inch	equals	2.54 centimeters (Approx. 2.5 c.m.)
1 Centimeter	"	0.3937 inch (Approx. 0.4 inch)
1 liter	"	1,000 cubic centimeters
1 liter	"	0.2642 gallon
1 liter	"	1.057 quarts
1 pint	"	0.473 liter
1 quart	"	0.946 liter
1 fluid ounce	"	29.57 cubic centimeters
1 fluid dram	"	3.7 cubic centimeters

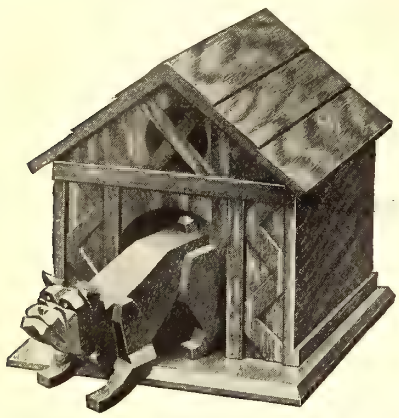
The gram is the unit of 1 cubic centimeter of water at 4 degrees Centigrade.

1 gram	equals	0.035 ounces (Avoirdupois)
1 gram	"	15.43 grains
1 ounce	"	28.35 grams
1 kilogram	"	1,000 grains
1 kilogram	"	2.2 pounds
1 Metric ton	"	1,000 kilograms
1 Metric ton		2,205 pounds

In our July issue Mr. Wilsdon will give us chemical definitions and he will show us how to perform simple chemical experiments.—Editor.

AN ELECTRIC PUP THAT HEEDS YOUR CALL.

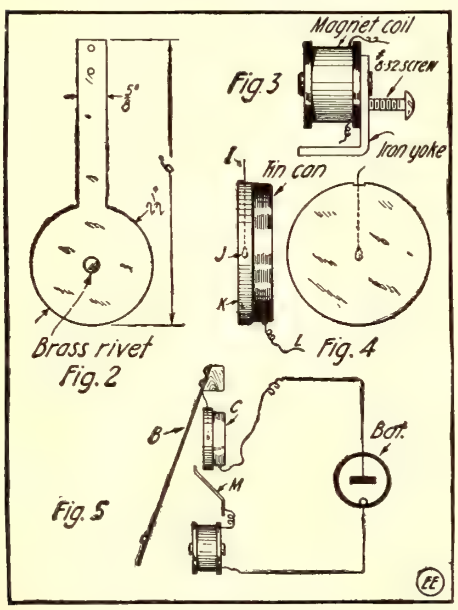
Here is an electric pup that will surely interest every electrical experimenter, not to mention his small brother or sister, as well as the rest of the family. All you have to do to call out his "reverence, the pup" from his kennel is to speak to him or blow a whistle. Electricity serves as the modus operandi. The pup himself is



This Electric "Pup" Comes Forth at Your Call.

about 4 to 5 inches long and about 3 inches high, being cut from wood on somewhat of a Cubist pattern. This wooden dog is made so as to slide along the floor of the kennel and out of the opening in the front of same.

The electrical apparatus operating this remarkable "hound" is perceived at A, B, C and D (Fig 1). A is a small electromagnet about the size of an ordinary 75-ohm telephone receiver spool and wound full of No. 26 insulated copper magnet wire. This is secured to the back of the coop by means of a screw fitted into the iron yoke of same, as indicated more in detail at Fig. 3. A rather stiff iron or soft steel spring B is supported on the tapered wooden block D. The position of this spring when not held down by the electro-magnet A is shown at Fig. 5, and, as becomes evident, if released quickly so as to assume the



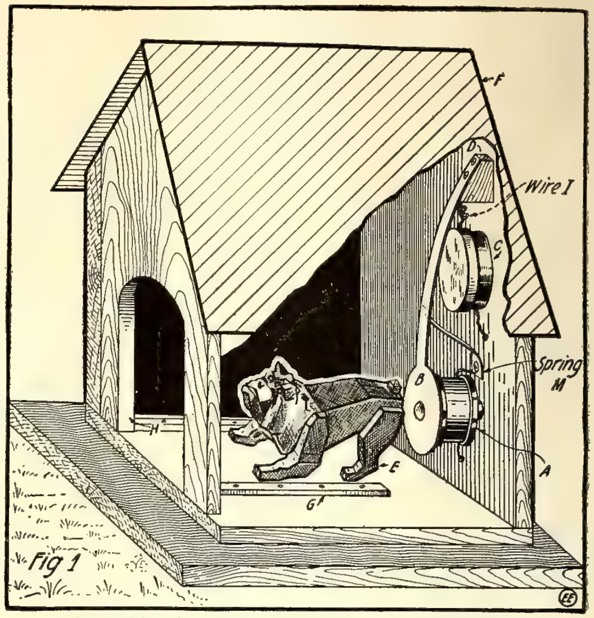
Details of Electrical Apparatus Actuating the Electric "Pup" Outfit.

position there depicted it will propel the pup forward and out of the kennel.

Below the block D is mounted a small tin can, such as those used for shoe polish. A hole is cut through the top to permit the entrance of a steel wire I. This wire does not touch the tin box C at the lower extremity J, Fig. 4, where a small graphite bob serves to hold it in very close proximity to the diaphragm K, which is at the same time the top of the box. A spring M helps to release the iron armature B. In the operation of the apparatus all of the parts must be adjusted carefully, so that the armature will just hold against the electromagnet faces at A. A brass rivet mounted in the center of the disc B helps to render the magnet quick releasing.

A small flashlight battery placed within the miniature doghouse operates the device in good fashion. Its action depends upon the fact that when a certain whistled note or voice sound impinges against the diaphragm K of the tin box C it causes same to vibrate; in so doing it makes and breaks the electric circuit as outlined at Fig. 5. The slightest variation in the strength of the circuit causes the electromagnet to release the spring B which must be reset by hand. The whole arrangement will now be thoroughly understood. It is best to have the diaphragm K tuned to some certain note and use a whistle or pitch pipe of this same note to call forth the pup from his domicile. In most cases clapping the hands once will bring him forth in a jiffy.

This "Wireless Pup" is now regularly manufactured by an Eastern manufacturer. A sample in possession of the editor works so well that the pup will jump from the kennel if a whistle is blown 15 feet away from the pup.



Assembly of the Electric "Pup" in His Kennel.

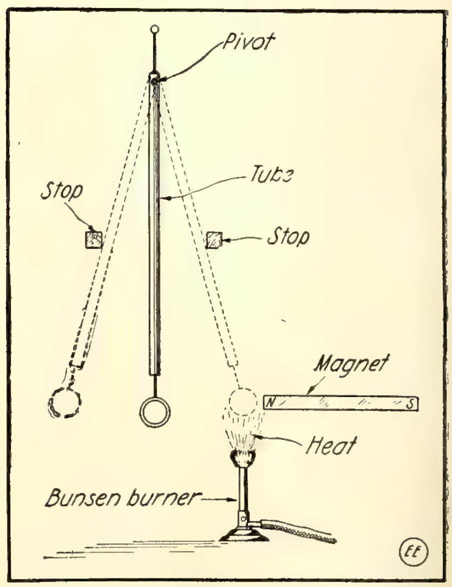
A SMALL LEAD STORAGE BATTERY.

A small lead storage battery can be made by putting two sheets of ordinary lead in a glass battery jar containing a dilute solution of sulphuric acid. To charge this battery connect the lead plates in series with an ammeter and a dry battery of four cells, giving about six volts pressure. While the current is passing, bubbles of gases will rise from each plate. After a few minutes, if the circuit is disconnected and the two wires attached to the lead plates are touched to a voltmeter, the meter will show a pressure of about two volts. If these wires are then connected in series with the ammeter and a small electric bell, the bell will ring, and the deflection of the ammeter needle will show the current to be passing in opposite direction to that used in charging the battery. When lifted out of the solution after charging the positive plate will be found to be colored brown, due to a coating of lead peroxide, while the negative plate will retain its usual gray color.

DEMONSTRATING EFFECT OF HEAT ON MAGNETISM.

A paper presented before the Société de Physique recently by M. Cotton cited the rapid disappearance of the magnetism of iron at a red heat, and he illustrated this action by an experiment in which the effect was readily seen. A long aluminum tube is arranged so as to swing freely from a pivot support at the top end, and means are provided to limit the swing by a stop piece. At the lower end of the tube is a curved platinum wire carrying a sheet-iron plate at one end. The device is placed near the poles of a strong magnet, so that the tube or pendulum swings toward the magnet, owing to the attraction exerted on the iron plate, and the pendulum is thus drawn to the limit of its swing. The flame of a large Bunsen burner, or other source of heat, is placed so as to entirely surround the iron plate when in this position, and when the latter reaches a red heat it loses its magnetic properties and ceases to be attracted, so that the pendulum now falls down to the zero position.

When the iron plate cools down it resumes its magnetic properties and is again attracted by the magnet, so that the plate enters the flame and becomes heated, and so on. In this way the pendulum is made to keep up a constant swing. On this principle the loss of magnetism by heat can be made the basis of a device which furnishes motive power, though in a small amount in the present case. It is an interesting experiment and upon such apparently non-important physical effects our whole electrical industry and science is based.

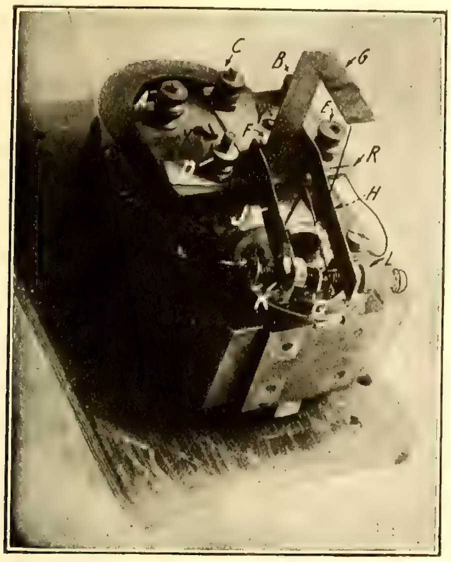


Demonstrating the Effect of Heat on Magnetized Iron.

An electric light is now made small enough to be attached to the ordinary dry battery cell. It will give a strong beam of light for several hours.

MAKING A MOVING COIL RELAY.

Many experimenters are in need of a very sensitive relay; one that is more responsive than the polarized type. The commercial instrument is beyond the means of the average experimenter, financially and mechanically.

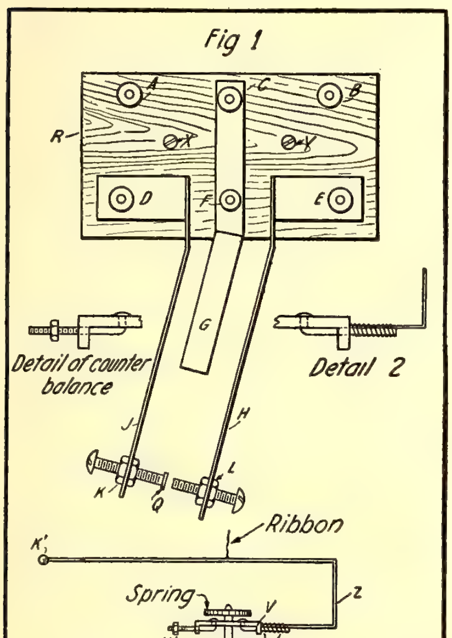


Sensitive Relay Constructed from Moving Coil Type Measuring Instrument.

Anyone having a moving coil type of Weston voltmeter or ammeter can make a very sensitive instrument. This instrument compares very favorably with high-resistance telephone receivers for detecting small currents.

The instrument shown in the picture gave a large deflection on .2 milliamperes. An old dry cell whose E.M.F. was about 1 volt (as it was polarized), operated the relay through more than 5,000 ohms resistance.

The case and scale should be removed from the meter and a suitable hardwood base prepared, with holes bored to correspond with the holes in the casting which supports the magnet and the moving coil.



Details of Moving Coil Relay.

The general make-up is shown in the photo and Fig. 1; R is the hard rubber or fiber base to support the contacts, about 2½ by 1½ inches and ⅛ inch thick. A and B are the binding posts for the line circuit. C and D are for the local circuit. Bolt E is to secure the stop arm H, and F is to secure the support G. The binding post D secures the contact arm J. The holes for the machine screws X and Y should be drilled to correspond with holes in the upright portion of the casting. The material for the arms J and H should be about No. 20 B. and S. gauge sheet brass. The angle at which the arms are bent is dependent upon the position of the moving arm at its neutral point.

At the extremities of the contact arm and stop, brass machine screws are placed. As it is difficult to thread the thin brass to fasten the screws to, the nuts K and L are soldered to the outside of the arms. The other two nuts are used to make the screws more secure. A silver or platinum contact point Q should be soldered to the screw as shown. The other arm does not need this, as it is only used as a stop for the moving contact arm.

The moving coil and arm are shown in Fig 2. The arm proper Z is made of No. 24 spring brass wire. The arm is bent to the shape illustrated to act as a balance. This is necessary in any place subject to vibration, etc., as on shipboard. If it is to be used in a quiet place the contact arm could be extended straight out at a right angle to the moving coil S and contacts thusly arranged. There are two methods of fastening the contact arm shown to the aluminum support V. Detail No. 2 is the least difficult. The aluminum needle was cut off as shown. The brass arm is then bound to it by fine thread and glued. In Fig. 2 the needle was removed and brass arm fitted into its place, but this is more difficult.

The upright G, Fig. 1, is to support a fine phosphor bronze ribbon, which may be obtained at an experimenters' supply house. Phosphor bronze is used as it is pliable and will not easily break. The ribbon is soldered to the arm G; the other end is soldered to the moving coil and in line with it. The ribbon is used to convey the current from the arm G to the contact arm Z. The silver or platinum contact K[1] should be soldered to the extremity of the arm on the side adjacent to the permanent contact Q. Both contacts should be filed parallel and made to line up nicely.

The counterweight U attached to the opposite end of the aluminum support V should be adjusted to balance the arm. The connections from the moving coil are taken from the screws which support the upper pivot bearing. The wires are then led to the line binding posts A and B.

The experimenter now has a very sensitive relay. If it is to be used for coherer work an auxiliary resistance will be necessary in order to reduce the current through the instrument, as it is necessary to use only a small current in this case. The instrument should be mounted on a large base and covered with some form of a case to keep out dust and dampness.

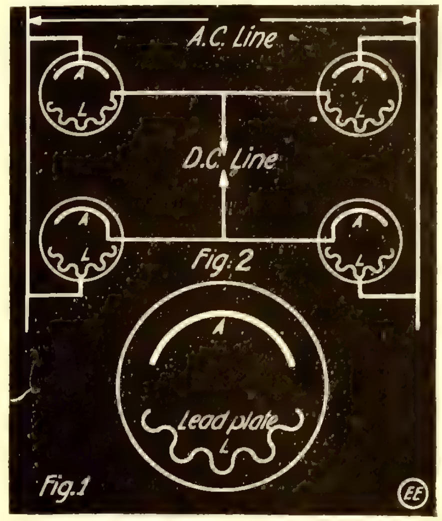
Contributed by R. S. RYBERG.

HOW TO MAKE AN ELECTROLYTIC RECTIFIER.

Many devices which will change alternating to direct current have been put on the market, but probably none of them suits the amateur as well as this one.

For the construction of such an instrument four two-quart fruit jars with two electrodes, one of lead and one of aluminum, for each jar are required. Place the electrodes in the jar, the immersed surface of the aluminum being about one-half that of the lead. To accomplish this, the lead plate should be crimped as in Fig. 1. In each illustration the lead is indicated as L and the aluminum as A. The solution consists of:

Water, two quarts; sodium bicarbonate, two tablespoonfuls; alum, three tablespoonfuls.



Improved Design for Electrolytic Rectifier.

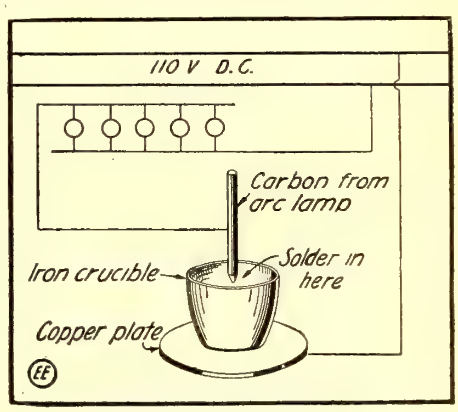
Make the connections as shown in Fig. 2. The alternating current comes in on the wires as indicated and the direct current is taken from the point shown in Fig. 2.

The capacity of this rectifier is from three to five amperes, which is sufficient for charging storage batteries, running a motor or lighting small lamps.

Contributed by
ALEXANDER V. BOLLERER.

USING AN ARC TO MELT SOLDER.

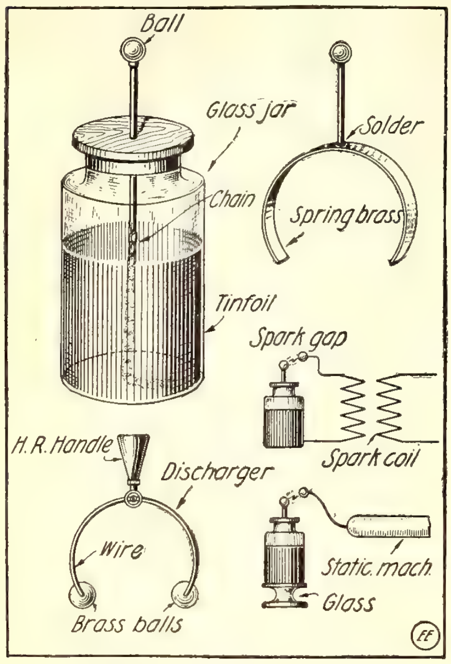
The electric arc, which is capable of producing the most intense heat of any device known to science, practically speaking, can be utilized very nicely for many every-day requirements, as, for instance, in the melting of solder. The solder is placed in an iron crucible resting upon a copper plate. An arc lamp carbon is used for the upper electrode with which to draw the arc from the solder. In series with this arrangement, there is placed a bank of lamps of the same rating as that of the circuit supplying the current. A water rheostat or other resistance may be used in place of the lamp bank if desired, says a writer in the *Electrical Review and Western Electrician.* After the arc is once struck the carbon electrode is held a short distance from the solder. The heat is so intense that it will melt it in a very short time.



Melting Solder with Electric Arc.

LEYDEN JARS.

In the year 1745 Von Kleist tried to collect electricity in a bottle of water by passing the current from his static machine down through a nail thrust through the cork of the bottle. He was indeed sur-



Leyden Jar Condenser Details.

prised when he found that he had really collected electricity in a bottle. This was the first Leyden jar, and from that time it has been improved greatly. Below are enumerated the qualities necessary in a good Leyden jar and the bad qualities in some poorly constructed jars.

The first consideration is the glass. It should be in the form of a wide-mouth jar to permit the inside coating of foil to be easily applied. The jar should be the best, hard, thin, Bohemian glass, free from lead, of uniform thickness, and also free from air bubbles and imperfections. The thinner the glass the greater the capacity, but the easier to puncture if overcharged. Glass showing a tinge of red color should be avoided, but glass with a *faint* greenish color makes excellent Leyden jars. When the jar is perfectly dry and cold, and is briskly rubbed with a silk handkerchief it should then produce a distinct spark when presented to your finger. Jars that hold this kind of electrification longest are most desirable. Last of all, the glass jar should ring clear and true when snapped with the finger.

Although many adhesives are used to hold the tinfoil to the glass, perhaps the best of all is banana oil, which is used in many gold paints. Shellac and thin glue may also be used. The higher the foil reaches toward the top of the jar the greater the capacity, and for wireless work the foil may extend quite near to the top. However, the less the height of the foil the longer it will hold the charge. When they are used in connection with a static machine the best height for the foil is about one-half the height of the jar. Foil should be put on the inside first, as it is then easier to see how smooth you are applying it. It is a good plan to coat the upper edge of the foil, both inside and out, with a good coat of thin shellac to prevent brush discharge.

The one place where a great many amateurs lose efficiency is in the cover for the jar. This had best be made of hard rubber or fibre, although very dry wood, heated well in an oven, and boiled in melted paraffin, is very satisfactory. The design of the cover must be left to the ingenuity of the individual, as it differs widely with different kinds of jars.

The brass rod which goes through the cover terminates on the inside with a chain and on the outside, in a brass ball (solid or hollow). The rod and ball should be perfectly smooth and polished to prevent the charge escaping from protruding points, as is its tendency.

Many amateurs do not know how to charge a Leyden jar with a spark coil, so that the jar will retain the charge. In order to do this one high-tension terminal of the spark coil must be directly connected to the outside coating of the Leyden jar and sparks allowed to pass between the other high-tension terminal of the spark coil to the ball terminal of the jar. If the sparks pass in a steady stream, make the gap a little longer until the sparks do not pass very steadily. A little experimenting will show the correct distance to obtain the best results. The best and safest way to discharge a Leyden jar is by means of a discharger in the form of a wire loop having ball terminals.

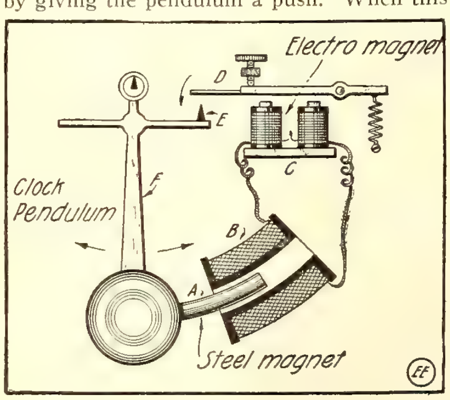
To charge a Leyden jar to full capacity by a static machine place the jar on an insulated base. Let the knob of the jar be close enough to the prime conductor of the static machine to allow sparks to pass. After working the static machine for a time the sparks stop. Now present your finger to the outside of the jar and sparks will pass between your finger and the jar and at the same time more sparks will pass between the prime conductor of the static machine and the knob of the jar. In a short time no more sparks will pass either between your finger and the outer coating of the jar or between the knob and the prime conductor of the static machine. The Leyden jar is now fully charged and should be handled cautiously, as the discharge from a large, fully charged jar taken through the body is not only very unpleasant, but is often painful and dangerous.

Contributed by D. J. THOMSON.

SOLVE THIS ELECTRICAL "PERPETUAL MOTION" PROBLEM AND WIN A PRIZE.

To those sending in the most concise and accurate statement as to why the electrically operated clock described herewith will or will not operate perpetually, we will give one year's subscription free to *The Electrical Experimenter* magazine.

The proposed electric clock has a regular swinging pendulum F, carrying a cross arm or projection E, at its upper extremity and at its lower end a permanent steel magnet A. Now suppose the clock is started by giving the pendulum a push. When this



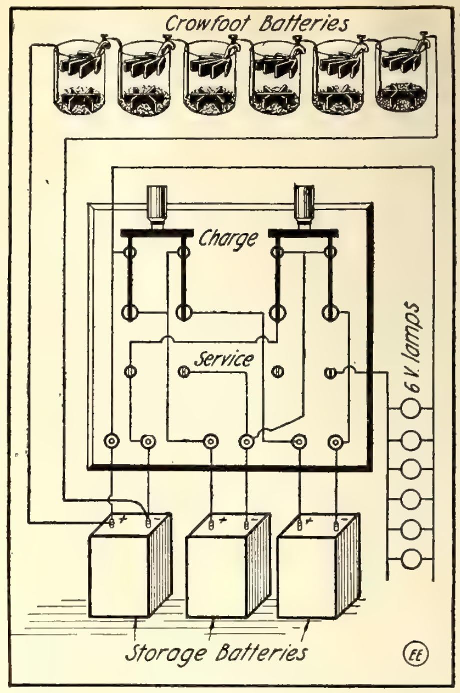
Can This Electric Clock Work Forever?

action takes place, the magnet moving through the hollow core of the solenoid or magnet winding B, produces a current therein and this current acts upon two electro-magnets C. The moment they are energized in this way they attract an iron armature D, which in its downward travel strikes the projection E attached to the pendulum rod, thus causing the pendulum to swing backward and repeat the operation. Apparently this device will keep on working to the end of time, the only difficulty being that it don't! Why not?

To facilitate our handling the replies, we request that the answers to this problem be stated in "fifty words or less." All communications should be addressed to the Editor, *The Electrical Experimenter* magazine, "Clock Contest." All replies should reach us not later than the thirtieth of this month.

USING GRAVITY BATTERIES TO CHARGE STORAGE CELLS.

A convenient method of charging storage cells with gravity batteries is outlined in the illustration herewith. A



Scheme Utilizing Gravity Cells to Charge Storage Battery.

change-over switch-board is shown, connecting to both sets of batteries, so that when the two switches are in one position, say "charge," the crow-foot cells will re-energize the storage batteries. When the switches are thrown in the position marked "service," the storage cells are connected in series to the lamp circuit as perceived. The storage cell connected across the charging mains should be transposed with the other cells periodically, as it will tend to charge faster than the others and also it will not discharge as fast as the rest, in view of the fact that the crow-foot cells are "floated" across the terminals of same. The gravity cells yield about .95 volt each and for each storage cell under charge, the potential developed by the source of energy used to replenish same should be figured at 2.75 to 3 volts. In this case the storage cells are connected in parallel while charging, so that three or four gravity cells in series will usually suffice.

Contributed by V. A. SCHYE.

Dr. Alexander Graham Bell, inventor of the telephone and one of the pioneer experimenters in aeronautics, has asked the Aero Club of America to urge Congress to establish postal air routes, in accordance with the plans recently outlined by the Post Office Department.

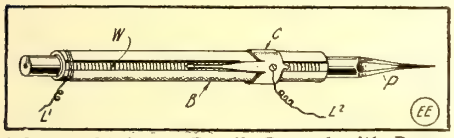
HOW TO MAKE IT

This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00

SIMPLEST VAPIABLE POCKET RHEOSTAT.

Use a slim lead pencil and wind it with two strands laid together, one of these being of fine resistance wire W and the other thread. Over this roll a strip of cardboard B, so as to leave a narrow strip exposed along one side. Bind the ends



A Layer of Wire on Pencil, Covered with Paper Together with the "Clip" Provides a Handy Rheostat.

of this and use a pen clip C, with a light spring for a slider. One lead should be soldered to the clip and the other is taken off at the beginning of the winding. Quite a wide range of resistance may be obtained from this instrument.

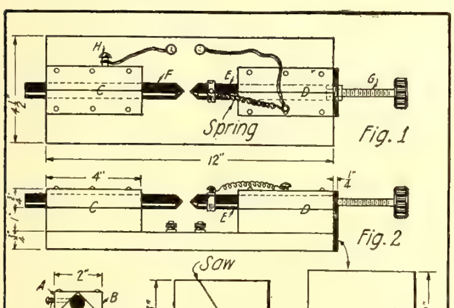
Contributed by ORVILLE HUISH.

EXPERIMENTAL ARC LAMP.

I give herewith details for making a simple hand feed arc lamp.

Fig. 1 shows a top view of the arc lamp, which, I think, requires no explanation. Figs. 3 and 4 show the pieces that hold the carbons (marked A and B). If a piece of wood 8 inches long, 1 inch wide and ¾ inch thick is marked off on the end as shown in Fig. 4, and is sawed at that angle, through the whole length, then if piece A is inverted, it will form the shape shown in Fig. 3, if the two pieces are nailed on a block 2x1x8. That will make a piece 1¾x2x8, which must be cut in half on the 4 inch mark, to make blocks C and D, each one holding a carbon as perceived.

A spring is used to pull carbon E away from carbon F. Adjusting screw G enables the arc to be altered in length as desired. The spring is also used to make connection with carbon E. A woodscrew H is used to connect carbon F and also to hold it firmly in place.



Useful Experimental Arc Lamp Made Mostly of Wood.

With an asbestos lined box placed over the lamp and an adjustable lens, the writer has shown slides and a spotlight over a block away. It may be put to many other uses of course. The box is best made of sheet iron and the base of slate or soapstone. Blocks C and D are well made of brass for a good job.

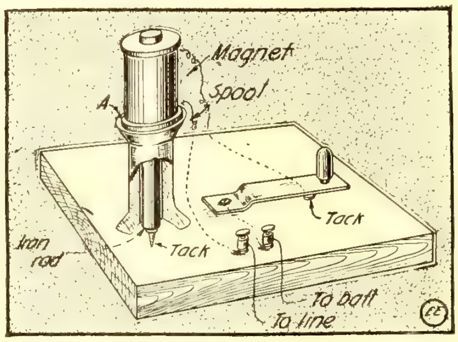
Contributed by LEONARD MABBOTT.

SECOND PRIZE $2.00

LOW-PRICED TELEGRAPH SET.

A common thread spool is nailed on a board and a piece of iron rod a little shorter than the spool itself should be procured to fit loosely within it. The rod should drop on a tack. An old bell magnet should be glued to the spool at A. The illustration clearly shows the strap key and connections. The manner in which this set works will surprise you.

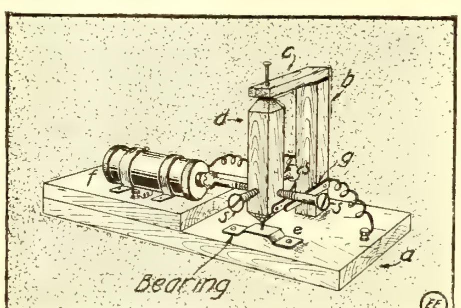
Contributed by PAUL KENNEDY.



Electro-Magnet Attracts Iron Rod within Spool. A Simple Telegraph Sounder.

NOVEL ELECTRIC ENGINE.

Herewith is a description of a Novel Electric Engine which can be constructed from a single electro-magnet, together with a wooden armature, in which are placed four iron machine or wood screws. The Electro-magnet f is strapped fast to the



The Simplest Electric Motor. Utilizes One Electro-Magnet, a Wooden Armature Fitted with Iron Screw Poles and a Pair of Brushes.

wooden base, and the armature d is supported in a foot step bearing e, and at the top by means of a nail driven in the end of the shaft, as in the drawing. The electrical circuit includes the electro-magnet, also the armature d, with a pair of spring metal brushes g in series with it. The battery is connected to a pair of binding posts mounted on the base of the engine.

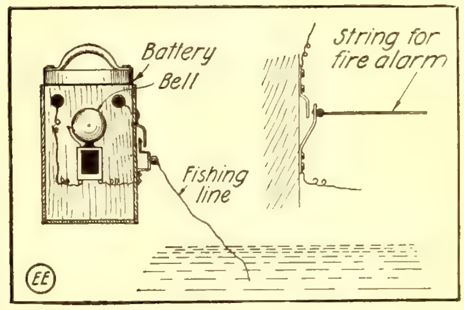
The brushes can be made of brass, copper or any metal that is quite thin and not too limber. The brushes, which need not be very wide, are placed as shown at g. The engine is now complete. The main part, after making the connections, is to have the brushes adjusted just right. Any mechanic can see without further explanation how it works. The illustration shows the adjustment of the brushes. This engine, when made correctly, will run at a high rate of speed.

Contributed by HARRY OSTNESS.

THIRD PRIZE $1.00

ELECTRIC SIGNAL FOR FISHERMEN.

On a cold, wet day fishing is liable to be a disagreeable task, and the following plan will prove of interest undoubtedly. An



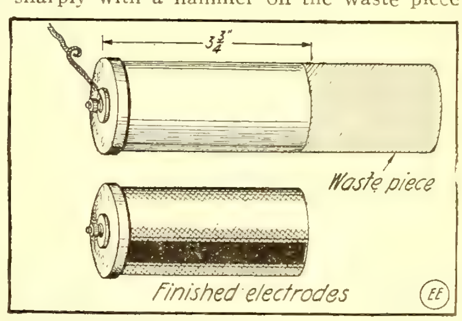
When a Fish "Bites" the Pull on the String Closes an Electric Bell Circuit.

electric bell is mounted on a box containing a flashlight battery connected to a spring switch or circuit maker. The illustration shows quite clearly how it is made. This same method may be used in a barn or house as a fire alarm if the string is kept normally taut, as shown. When the hay loft burns, for instance, the string will break, releasing the switch spring.

Contributed by HARRY RILEY.

HAND ELECTRODE FOR MEDICAL COILS.

Procure two flat-top battery carbons and boil them for several minutes to remove incrusted salts, paraffine, etc. Measure off 3¾ inches, or any convenient length, and file a deep groove all around. Then strike sharply with a hammer on the waste piece



Medical Coil Electrodes Made From Battery Carbons.

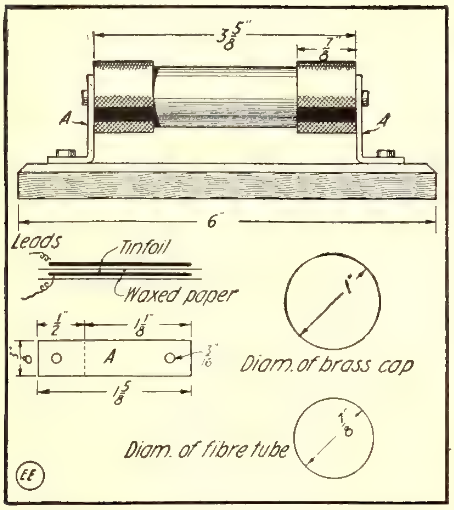
side of the groove until the carbon breaks at this mark. File the rough end until smooth and the electrode is finished.

Contributed by N. ROHACS.

FIXED CONDENSER IN FUSE CARTRIDGE.

A neat and effective fixed condenser can be made out of a blown 125-ampere cartridge fuse. Take off one of the brass caps and cut off the tube so that it will be 3½ inches long. Now take two strips of brass, A, 1⅝ inches long by ⅜ inch wide, and bend according to drawing. Then bore two 3/16 inch holes in each end.

The condenser may comprise two pieces of tinfoil 44 inches long and 2½ inches wide, also two pieces of waxed paraffined paper 46 inches long and 3 inches wide. Place the tinfoil as in drawing, roll tightly and when almost at the end place two



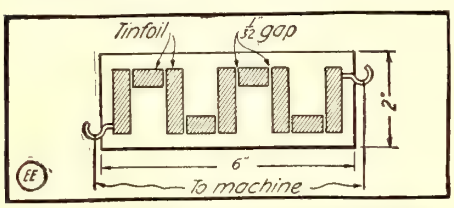
Compact Fixed Condenser in Cartridge Fuse Shell.

wires about three inches apart, under the tinfoil and waxed paper. Place it in the fiber tube, solder the wires to the caps, and put together. Any size piece of wood will serve as a base, but the one about 6 inches by 2½ inches is best.

Contributed by A. W. O. LARSON.

A NOVEL SPARKING EFFECT.

The following apparatus can be very quickly and easily constructed, and the results obtained will fully repay the two or three minutes set aside to do so. All that is needed is a piece of stiff cardboard, a little tinfoil and paste. Cut the tinfoil into rectangular strips and paste them end to end on the cardboard, as shown in the illustration, leaving a very small air gap between them. Now arrange some kind of



Multiple Spark Apparatus for Entertainments.

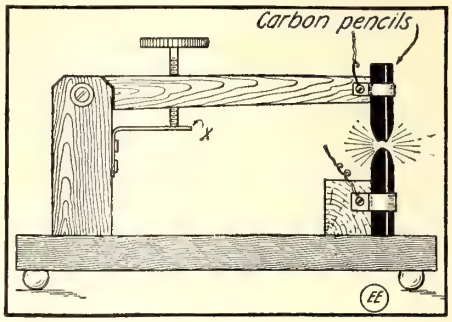
hook on both ends, as shown, and attach it to a static machine or spark coil. When in action numerous sparks will be seen to pass between the air gaps, producing a very pleasing effect in the dark. It is clear that the tinfoil can be cut so as to form different designs if desired, such as letters in script, etc., providing the air spaces between them are not too great. A 1/32 inch gap is sufficient usually.

Contributed by JAS. GERSCHLER.

Make your wireless station comply with the Underwriters' rules; it will pay in the end.

NOVEL HAND FEED ARC LAMP FOR AMATEURS.

Herewith is described an unusually simple yet efficient electric arc light for use during brief periods of photography where a substantial illumination is required.



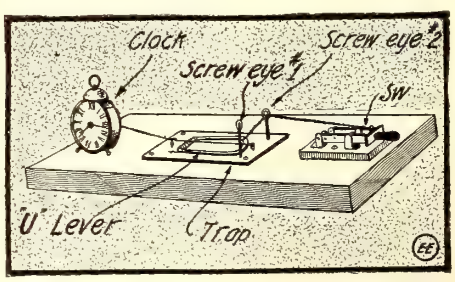
Arc Lamp of Simple Construction.

Using the short lengths of carbons discarded by moving picture operators, there is no difficulty in maintaining a brilliant arc for several minutes without once manipulating the adjusting screw at the top. Only three pieces of wood (slate is better) are necessary, and in the preparation of these no particular care need be exercised except to have the top arm swing freely up and down, and without any appreciable side movement. The carbon holders are merely strips of heavy tin, which need only be screwed up sufficiently tight to hold the carbon sticks. The illustration explains everything, and a sort of arm made from thick tin or brass (X), bent at 90 degrees, will assist the adjustment of the carbon by the long, slender wood screw threaded in the wood bar, as perceived. This thumb-screw is easily operated and a very minute adjustment of the carbons affected to about 1-32 of an inch accuracy. In operating any arc light on the commercial 110-volt current some ballast resistance must be placed in the circuit. An earthen jar filled with water, with two strips of tin or lead for electrodes, will answer this purpose. It is a valuable addition to any photographic laboratory.

Contributed by WM. WARNECKE, JR.

TIME SWITCH.

An ordinary 10-cent spring mouse trap is all that is required outside of the usual switch (D. P. S. T. type), and an alarm clock. Mount them on a base in the order shown. Two screw eyes are put in, one on a pillar (2) and one put lower at 1. A string is attached to the winding key of the clock and to the mouse trap trigger. At the "set time" the trigger will trip and the "U" lever will fly over. If the switch is to be opened a string is run from the "U" lever, through screw eye 2 and to the switch handle. If it is desired to close



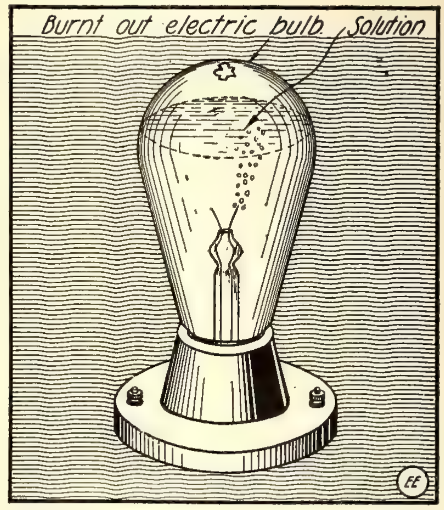
Time Switch Made from Ten Cent Mouse Trap, Alarm Clock and Switch.

the switch run the string through the lower screw eye. Another use to which the mouse trap may be put is to open and close the shutter of a camera. Then a string is run from the clapper of an electric bell to the trigger and also a string to the shutter from the "U" lever. Set the bell to ring for an instant and the trigger will be disturbed. The gong should be removed from the bell.

Contributed by I. ROSIN.

POLARITY INDICATOR MADE FROM AN OLD ELECTRIC LIGHT BULB.

Perhaps some of the readers of *The Electrical Experimenter* need a polarity indicator, but find the battery type more or less clumsy. The writer made one from a burned-out incandescent light bulb. First knock off the glass tip, leaving a small hole, through which a fine wire is inserted to break off the filaments, leaving the two larger wires, as illustration shows. Next make a solution of salt water, which is poured into the bulb through the hole by means of a small funnel. By screwing this into a socket and switching on the current



Polarity Indicator Made From Lamp Bulb Filled with Salt Water.

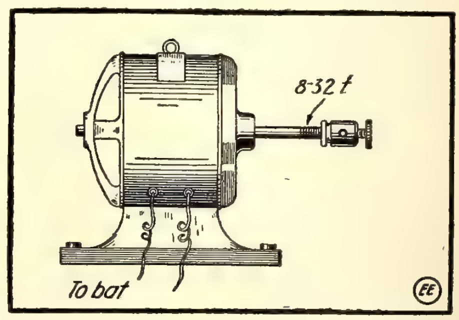
the negative pole can be ascertained by the bubbles which rise from it.

(By breaking off the tip of the lamp, under the solution of salt water, by means of a pair of pliers the bulb will fill itself.—*Editor.*)

Contributed by AN EXPERIMENTER.

HOME-MADE POLISHER FOR BINDING POSTS.

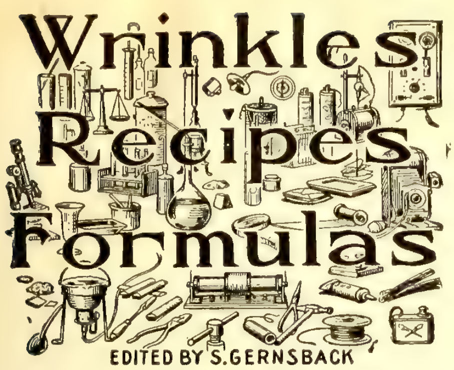
After fastening the binding post to the motor shaft according to the accompanying illustration a piece of sandpaper or emery cloth is held against the post until all dirt and rust is cleaned off; then some metal polish on a rag is held against it, with the



Binding Post Polisher.

final polish being made by using a dry cloth.

Contributed by FRANCIS R. PRAY.



EDITED BY S. GERNSBACK

Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 22.
Bronzing Compositions.

Silver White Bronzing Powder.—Melt together 1 oz. each, bismuth and tin, then add 1 oz. quicksilver, cool and powder.

Gold Colored Bronze Powder.—Verdigris, 8 ozs.; putty powder, 4 ozs.; borax and nitrate, of each 2 ozs.; bichloride of mercury, ½ oz.; make into a paste with oil and fuse them together. Used in japanning as a gold color.

Beautiful Red Bronze Powder.—Sulphate of copper, 100 parts; carbonate of soda, 60 parts; apply heat until they unite into a mass.

Antique Bronze Paint.—Sal ammoniac, 1 oz.; cream of tartar, 3 ozs.; common salt, 6 ozs.; dissolve in 1 pt. hot water; then add nitrate of copper, 2 ozs.; dissolve in ½ pt. of water; mix well and apply it to the article in a damp place with a brush.

Blue Bronze on Copper.—Clean and polish well, then cover the surface with a fluid obtained by dissolving vermillion in a warm solution of sodium, to which some caustic potash has been added.

Bronze Dip.—Sal ammoniac, 1 oz.; salt of sorrel (binoxolate of potash), ¼ oz.; dissolved in vinegar.

Parisian Bronze Dip.—Sal ammoniac, ½ oz.; common salt, ½ oz.; spirits of hartshorn, 1 oz.; dissolved in an English qt. of vinegar. A good result will be obtained by adding ½ oz. sal ammoniac instead of spts. of hartshorn; the piece of metal when well cleaned is to be rubbed with one of these solutions, then dried by friction with a fresh brush.

Green Dip.—Wine vinegar, 2 qts.; verdigris, 2 ozs.; sal ammoniac, 1 oz.; salt, 2 ozs.; alum, ½ oz.; French berries, 8 ozs.; boil the ingredients together.

Aquafortis Dip.—Nitric acid, 8 ozs.; muriatic acid, 1 qt.: sal ammoniac, 2 ozs.; alum, 1 oz.; salt, 2 ozs.

Olive Bronze Dip for Brass.—Nitric acid, 3 ozs.; muriatic acid, 2 ozs.; add titanium or palladium, when the metal is dissolved add 2 gals. pure soft water to each pt. of the solution.

Brown Bronze Paint for Copper Vessels.—Tinct. of steel, 4 ozs.; spts. of nitre, 4 ozs.; blue vitriol, 1 oz.; water, ½ pt.; mix in a bottle, apply it with a fine brush, the vessel being full of boiling water. Varnish after the application of the bronze.

Bronze for All Kinds of Metal.—Muriate of ammonia (sal ammoniac), 3 drs.; oxalic acid, 1 dr.; vinegar, 1 pt.; dissolve the oxalic acid first; let the work be clean, put on the bronze with a brush, repeating the operation as many times as may be necessary.

Green Bronze.—Dissolve 2 ozs. nitrate of iron, and 2 ozs. hyposulphate of soda in 1 pt. of water; immerse the article until the required shade is obtained, as almost any shade from brown to red can be obtained according to the time of immersion, then wash well with water, dry and brush.

Pale Deep Olive Green Bronze.—Perchloride of iron, 1 part; water, 2 parts. Mix and immerse the brass.

Dark Green.—Saturate nitric acid with copper and immerse the brass.

Dead Black for Brass Work.—Rub the surface first with tripoli, then wash it with a solution of 1 part, neutral nitrate of tin, with 2 parts, chloride of gold, after 10 minutes wipe it off with a wet cloth.

Best Bronze for Brass.—Take 1 lb. of nitric acid, and ½ lb. of white arsenic, put them into an earthen vessel and then proceed in the usual manner.

Another Bronze for Brass.—1 oz. muriate of ammonia, ½ oz. alum, ¼ oz. arsenic, dissolve together in 1 pt. of strong vinegar.

Black Dip for Brass.—Hydrochloric acid (commonly called smoking salts), 12 lbs.; sulphate of iron, 1 lb.; and pure white arsenic, 1 lb. This dip is used in all the large factories in Birmingham, but the dip used in the London trade is 2 ozs. corrosive sublimate, in 1 pt. of the best vinegar, cork both in an air-tight bottle, let it stand 24 hours; then it is fit for use.

Quick Bright Dip for Brass.—Use strong nitric acid in sufficient quantity, dip your brass in the liquid for an instant, withdraw, and immediately immerse it first in cold water, and then in boiling water, for a short ime only in each bath, then allow it to dry; repeat the process if necessary.

Application of Bronze Powder.—The proper way is to varnish the article and then dust the bronze powder over it after the varnish is partly dry.

Black Color for Brass Work.—Make a strong solution of nitrate of silver, and nitrate of copper separately. Mix the two together and plunge in the brass. Now heat the brass evenly till the required degree of blackness is acquired. Unrivalled as a beautiful color on optical instruments.

VALUABLE HINTS FOR THE AMATEUR.

Bronzing Fluid.—(For brown). Iron filings or scales, 1 pound, arsenic 2 ounces, hydrochloric acid, 1 pound; metallic zinc, 1 ounce. The article to be bronzed is dipped in this solution till the desired effect is produced.

Sealing Wax.—(Red). Take 4 pounds shellac, 1½ pounds turpentine, 3 pounds finest cinnabar and add 4 ounces Venetian red. Mix the whole well together and melt over a very slow fire. Pour it on a thick smooth sheet of glass or any other flat surface and make it into sticks.

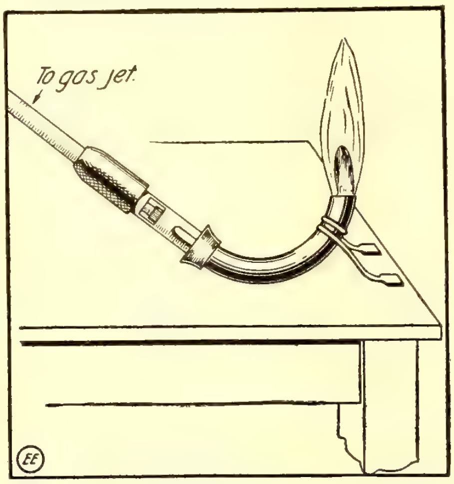
(Black). Take the best black resin, 3 pounds; beeswax, ½ a pound and finely powdered ivory black, 1 pound. Melt the whole together over a slow fire and mould into sticks.

Waterproof Compound.—Suet, 8 ounces; linseed oil, 8 ounces; neatsfoot oil, 1½ ounces; lampblack, 1 ounce; litharge, ½ ounce. Melt together and stir till cold.

Contributed by H. G. FRANK.

BUNSEN BURNER.

Recently I was in need of a Bunsen burner, and, not having one, hunted about for something to take its place. I found an old gas burner, the kind that is used with a mantle, and which can be purchased for a few cents. It was bent in the shape depicted in the illustration. By wrapping some heavy wire around the tube it can



Cheap Bunsen Burner Made From Gas Mantle Parts and a Piece of Wire.

be made to stand in an upright position. This burner will take the place of those costing 50 cents or more.

Contributed by P. M. RAMSEY.

SOLDERING FLUXES AND INSULATING VARNISH.

AN EXCELLENT SOLDERING FLUX.

This may be made by saturating a solution of zinc chloride in water and adding by weight one-tenth part of ammonium chloride. It is claimed that with this flux it is possible to solder enamel ware. This is impossible with most other fluxes.

A GOOD FLUX FOR SOLDERING TINFOIL.

This flux can be made by mixing salammoniac (ammonium chloride) with vaseline and paraffine so as to form a paste. When soldering tinfoil it is advisable to lay the tinfoil on a sheet of copper, which conducts the heat away from the tinfoil. Otherwise the foil would be likely to melt.

INSULATING VARNISH.

White shellac 4 ounces, black amiline dye 1 tablespoonful. The aniline dye must be soluble in alcohol only. This mixture, if correctly made, when laid on with a soft brush will produce a shiny black surface, giving the instrument a neat appearance. It must be laid on quickly, as it sets in a few seconds.

Contributed by
CARLISLE SHANNON.

SOME INTERESTING CHEMICAL EXPERIMENTS.

Fire-Proofing Cloth.—First get two glass tumblers. Add two teaspoonfuls of ammonium chloride to the water in the glass and stir until dissolved. In the other glass put a piece of cotton cloth two or three inches square and then pour the dissolved ammonium chloride into the glass containing the cloth and see that it is well soaked with the solution. Hang the cloth up and let it dry. Then touch it with a lighted match. It will burn in the flame, but will go out as soon as the flame is removed.

To Make Gun Powder.—Mix one teaspoonful of potassium nitrate, one-half teaspoonful of sulphur and one-half teaspoonful of powdered charcoal on a sheet of paper. This must be thoroughly mixed to make a good powder.

Sympathetic Ink.—With a clean steel pen write on white paper with a cobalt chloride solution and let dry. When the paper is held near a fire the writing will gradually appear, and disappear again when it cools, because the chloride absorbs moisture from the air. Even though the paper is scorched the writing will still be visible.

Green Alcohol Light.—Dissolve one-half teaspoonful boric acid in two and one-half teaspoonfuls of alcohol and light it. The flame will be bright green.

To Remove Marks Due to Match Scratches.—Rub the scratched surface with lemon and then wash with a clean rag dipped in water.

Contributed by
RICHARD GAILLARD.

Experimental Chemistry

By Albert W. Wilsdon

ELECTRICITY and Chemistry are so closely related to each other that the study of one without the other tends to make the student and the experimenter very one-sided indeed. We might state that there can be no first-class electrician who has not a fair knowledge of chemistry. Great electricians such as Volta, Faraday, Ampère, Planté, Edison and countless others were all good chemists.

That is the reason for beginning our "Experimental Chemistry" in this issue. Chemistry is such an interesting study that we feel certain that all experimenters will welcome every installment. The course will extend over one year and as its name proclaims, it will be strictly experimental. The able author, Mr. Wilsdon will not feed us with formulas and theories—there are text-books for this purpose—but he will show us how to perform chemical experiments, using simple, non-technical language. We have every reason to believe that you will like the new department. EDITOR.

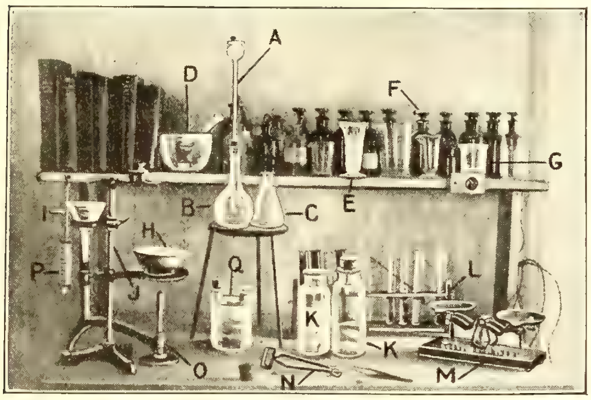
Apparatus.

MOST prospective students in chemistry are of the belief that a very elaborate and expensive laboratory equipment is necessary, but the purpose of this article, besides giving the elementary principles of chemistry, is to afford the average amateur with instructions for equipping a laboratory on an economical basis.

If the reader can afford it, I would advise that a set of glass stoppered reagent bottles be purchased. If these bottles are bought, obtain them with the name of the reagent and symbol blown in the glass, if possible.

List of Apparatus.

Two pieces asbestos, 4x4 inches; 1 balance scale with metric weights; 1 jeweler's blowpipe; 1 test tube brush; 1 Bunsen burner; 1 test tube clamp for test tubes, etc.; 1 porcelain crucible, No. 00 with lid; 1 evaporating dish, No. 0; 1 round file; 1 triangular file; 1 pair iron forceps, 4 inches; 1 piece iron gauze, 5x5 inches; 1 glass cutter; 1 mortar and pestle,



A—Thistle Tube. B—Florence Flask. C—Erlenmeyer Flask. D—Mortar and Pestle. E—Graduate. F—Reagent Bottles. G—Beaker. H—Evaporating Dish. I—Funnel. J—Ring Stand. K—8 ounce Bottles. L—Test Tube Rack and Tubes. M—Balance Scales. N—Test Tube Holder. O—Bunsen Burner. P—Test Tube Brush. Q—Wolff Bottle.

1 package filter paper, 4 inches; 1 test tube rack to hold 12 test tubes; 1 combustion spoon; 1 ring stand with 3 rings; rubber stoppers, assorted sizes, Nos. 0 to 5, one and two hole; 1 tripod, iron; 1 pipe stem triangle; glass tubing; 1 foot rubber tubing to fit glass tubing snug; 2 beakers, 100 c.c.; 1 beaker, 250 c.c.; 4 eight-ounce bottles; 2 two-hole stoppers and 1 one-hole stopper to fit above; 2 Florence or Erlenmeyer flasks; 1 Metric graduate, 25 c.c.; 4 glass plates, 4x4 inches; 6 or 12 test tubes, 6x¾ inches; 1 Thistle tube; 1 glass funnel.

The above apparatus can be purchased as required.

Laboratory Operations.

When measuring liquids, always read from the lower meniscus, as shown in the illustration.

If you spill any powder or liquid on the work table, wipe it up as soon as possible. Do not let it remain on the table for any considerable length of time without wiping it up.

When mixing Sulphuric Acid, ALWAYS REMEMBER that the water must NEVER be added to the acid. The correct way to mix this acid is to pour the water into a vessel, and add the acid, in small quantities, while keeping the liquid in constant movement by stirring.

When pouring a liquid into a test tube, extend the arms as far as possible and keep the middle of the tube on a level with your eyes. Never hold the tube close to your body, with your face over the tube, while pouring in a liquid.

Always do exactly as the experiment tells you. If the experiment calls for 5 grams, use 5 grams, otherwise you will not obtain the desired results.

Wash your test tubes and bottles after each experiment. Do not leave them for any length of time, as they will be much harder to clean.

Concentrated Acid means acid of the indicated specific gravity. Hydrochloric acid has a specific gravity of 1:19; Nitric acid has a specific gravity of 1:42, and Sulphuric acid of 1:84. Concentrated Ammonia should have a specific gravity of 0.09.

Diluted Acids (and Ammonium Hydroxide):—

Dilute 1 part of Ammonium Hydroxide with 4 parts of Water.

Dilute 1 part of Hydrochloric Acid with 4 parts of Water.

Dilute 1 part of Sulphuric Acid with 6 parts of Water.

Dilute 1 part of Nitric Acid with 4 parts of water.

The Metric system is the general unit of weights and measures in chemistry and all the experiments will call for the Metric weights.

Glass Working.

CUTTING GLASS PLATES:—

Lay the plate of glass on a perfectly smooth surface, and measure off the required distance from the edge of the plate. Now place a ruler on the plate in a line with the part to be cut, and with the left hand hold it in place. Take the glass cutter in the right hand and draw it over the glass (guided by the ruler), using a little pressure, and until you hear a distinct scratching noise. Now pick up the glass and with the side having the scratch away from you press gently outward with the thumbs and inward with the fingers. This should leave a fairly smooth edge.

BREAKING GLASS TUBING:—

Make a sharp scratch on the desired part of the tube with a triangular file. Make ONE SCRATCH, do not saw back and forth. Fig. 2 shows the method of accomplishing this.

FIRE POLISHING:—

After you break a piece of glass tubing hold it in the flame of a Bunsen Burner until the ends of the glass just begin to soften.

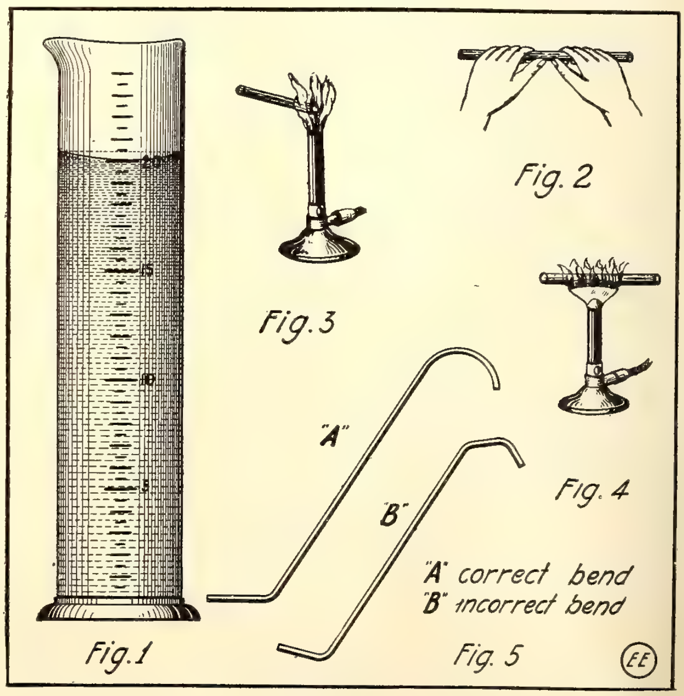
Fig. 3 shows the method.

BENDING GLASS TUBING:—

Use a "fish-tail" burner, which gives it a broad flat flame (Fig. 4). Hold the tube lengthwise in the flame so that the full heat of the burner will be centered on about two inches of the tube. Roll the tube between the fingers, so that the heat will be evenly distributed, but do not bend it or allow it to bend, while it is in the flame. The first indications that the tube is softening will appear when the flame turns to a yellow color. As soon as the heated portion of the tube is soft TAKE IT FROM THE FLAME and bend it at the angle which you desire. Do not put it on anything except the asbestos pad while it is hot. All bends should have the same diameter at the bend as at any other part of the tube.

In fitting a glass tube to a rubber stopper, ALWAYS run some water in the hole and wet the tube before inserting, otherwise the tube might break and cause serious results. A little common sense and care are prime requisites to good results.

(*Continued on page 103*)



Glass Bending Operations and Meniscus Measuring Graduate.

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

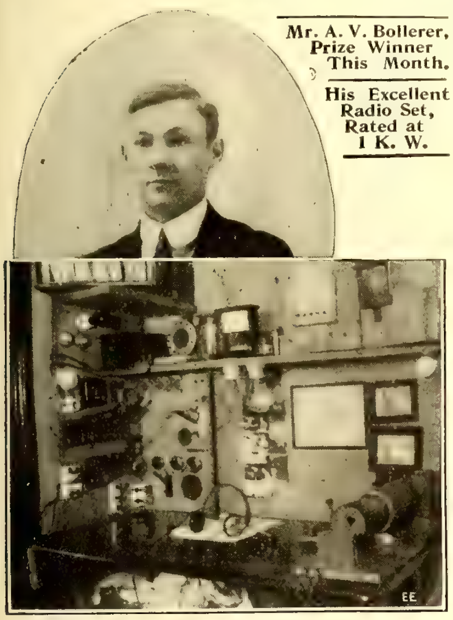
AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

WIRELESS STATION OWNED BY ALEXANDER V. BOLLERER.

The sending set of my station comprises a Blitzen 1 K.W. transformer, 110 volt



Mr. A. V. Bollerer, Prize Winner This Month.

His Excellent Radio Set, Rated at 1 K. W.

rotary gap with an oscillation transformer and suitable condenser, also a key with large heavy contacts. The receiving set consists of the following: Long wave loose coupler having a Murdock variable condenser shunted across the secondary, with a condenser also in series to vary the short wave length of incoming stations.

In the secondary I have an E.I.Co. sliding plate condenser in shunt, the two latter condensers are controlled by the two S.P.S.T. switches on the switchboard shown at the left of the illustration.

Now a word about the detectors. There are four, one silicon, one galena, one Audion and a Radioson, which are connected to the loose coupler by a switch system. There are two D.P.D.T. switches employed, the leads from the secondary of the coupler running to the center of one, and the center pole of the second switch connected to one side of the other, thus allowing the operator to use either detector by a throw of the switch. Storage batteries are the source of current to light the Audion filaments.

There are two sets of 'phones in the station, one Brandes' 3,200 ohm Navy, which is shown on the table, and the other one E.I. Co. 3,000 ohm Government set. By means of the four point switch it is possible to connect either pair of 'phones to the detector.

The two aerials which are employed with this set may be used independent of each other, or together as the operator desires. One is composed of two wires 50 feet high and 80 feet long and the other 275 feet long and 85 feet high; both are made of phosphor bronze wire.

My station is in my bedroom and it affords me great pleasure to spend the evening there listening to various stations working. Many evenings when Arlington is sending, or some other powerful station, I can lay the receivers on the table, go to bed and still hear them sending. Then when I have had enough I can shunt the 'phones by means of a small switch on my bed.

I am getting very good results with this station and hear many amateurs within a radius of 500 miles. I can hear a 1/4 K.W. set 250 miles away and a 3/4 K.W. set 800 miles from my station. Within 300 miles my signals can be heard very strongly. Many times I hear Key West and Colon working. With the 'phones on the table, time from Arlington and Key West is received very often. I can hear N.A.R., Key West; N.A.X., Colon; and a number of other long distance stations. I have a radio license from the government and my call is 1 V.H.

I would like to hear from other amateurs within my radius and would be highly pleased to receive photographs of their stations or exchange pictures of our respective sets.

ALEXANDER V. BOLLERER.
New Britain, Conn.

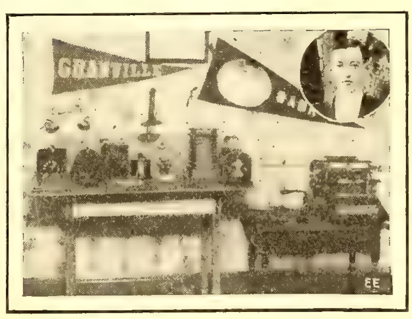
R. H. HOWE'S RADIO STATION.

Wireless telegraphy has come into practical use so rapidly that the majority of the people hardly realize the vast work that is being accomplished, especially among the amateurs, along this line.

It may be interesting to know that my interest along the line of wireless was created by purchasing an E. I. Co. 10 cent detector.

From then on I have been constructing and adding more instruments to my set until now I have the outfit which you see in the accompanying illustration.

The transmitter consists of a 1½ inch Bull Dog spark coil, helix, stationary gap, one Leyden jar and a glass plate condenser. The source of power is a 6 volt, 60 A. H. storage battery. A telegraph sounder and



Radio Set of R. H. Howe.

a portable key is connected to a telegraph line running to the home of a friend a few houses away.

Due to the lack of alternating current in our town, I am unable to transmit to any great distance, but I get splendid results from my receiving set. N.A.R. comes in very distinctly and I get the time and copy press from N.A.A. daily. I copy the weather forecast for Ohio, sent out daily by Ohio State University and I display it at our High School. I also hear many commercial stations and nearby amateurs.

I hold a government amateur license, my official call being 8 A.B.R.

RICHARD H. HOWE
Granville, Ohio.

AMATEUR RADIO STATION OF CEDRIC E. HART.

The photograph and description of my station which are submitted herewith, I hope to see among those published in the Amateur Radio Station Contest.

The receiving set is as follows: 4,000 meter Marconi type loose coupler, Murdock variable condenser, E.I.Co. Junior fixed condenser, a high toned (high pitch) buzzer test, galena, perikon and silicon detect

Effective Radio Station of Cedric E. Hart, of Salt Lake City, Utah. He is a Member of the Radio League of America.

ors as well as an Audio-Tron bulb and a Brandes' 2,000-ohm headset.

The transmitting outfit comprises ½ K.W. Thordarson transformer, kick-back preventer, commercial key, rotary and fixed gaps, .01 M.F. condenser (under receiving table) and also an oscillation transformer, with a helix connected in series with the antenna which is 94 feet long, 50 feet high at one end and 20 feet at the other, containing four wires of No. 14 "Antenium" wire spaced 2 feet apart and then run through a large lightning switch to the set.

Among the stations that I receive are the following amateur, commercial and experimental ones: 6 P.A., 6 R.C., 6 A.C.S., 6 Z.V., N.P.L., N.P.K., N.P.E., N.P.R., N.P.M., K.J.A., K.P.A., K.P.H. and many others that I can not locate.

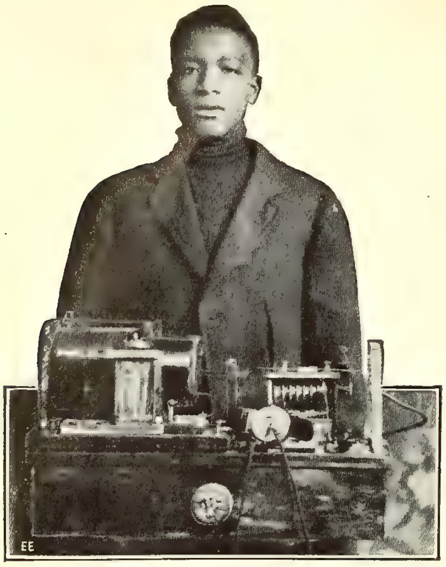
I am a member of several radio clubs, including the "Radio League of America" and "The Utah Radio Research Association."

CEDRIC E. HART.
Salt Lake City, Utah.

Don't forget your wireless set during the vacation period. If you go away for a trip take at least a small receiving set with you. It always pays.

PORTABLE WIRELESS SET OF LILBERT YOUNG.

The author takes great pleasure in sending in this illustration and description of his portable radio station. The receiving



Lilbert Young's Home-made Radio Outfit.

set consists of a large loose coupler, a Jove mineral detector, fixed and variable condensers and a 1,000-ohm Brandes' 'phone. For sending there is used a ½-inch spark coil, an E.I. Co. key, glass plate condenser, a "pancake" helix and a stationary spark gap. These instruments are mounted on a neat cabinet which has a small switch in front that controls the buzzer test and shunts the detector. A D.P.D.T. switch is also located on the left side, which is a very convenient place. With the exception of the 'phone and detector all instruments are home made. This station is used mostly for receiving and on favorable nights many distant commercial stations come in very loud.

The sending range is not so great, due to the fact that such a small coil and aerial only 40 feet long and 30 feet high are used. The writer is very much pleased with the results he has obtained with this station and proud to say that many useful ideas about its construction came from *The Electrical Experimenter.* My call is L.Y. and I will be glad to hear from amateurs within a radius of three miles.

LILBERT YOUNG.
Indianapolis, Ind.

CORRECTION NOTICE.

We are asked to state that the station shown on page 626 of our March issue of the magazine is not the property of the Minnesota Wireless Association, but of the American Telegraph School of Minneapolis, Minn.

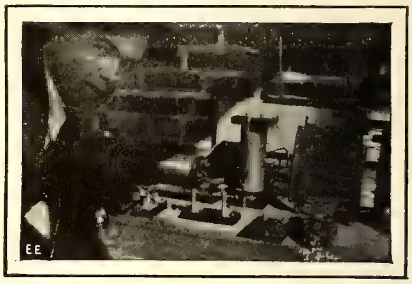
RADIO TAUCHT IN PRISON.

Wireless telegraphy has been introduced by Warden George W. Kirchwey at Sing Sing prison, New York, as a part of the curriculum of the prison schools. Most of the inmates are proficient in "prison wireless," the term applied to the underground system of relaying news to and from the prison, and are expected to quickly master the new system. Henry Leeb, a graduate of the Massachusetts Institute of Technology, was the first lecturer on the subject. It is planned to train the operators thoroughly in the use of wireless, so they can take a job on land or sea when released.

THE RADIO SET OF J. Y. PARSONS, JR.

Herewith is an illustration of my wireless station, all of which is home made, with the exception of the spark coil, 'phones and key.

The receiving set consists of a loose coupler, fixed condenser, variable condenser, single slide tuning coil used as loading coil, 1,000-ohm 'phones, buzzer test and galena, silicon and iron pyrites detectors. In the sending set there is a 2-inch coil, glass plate condenser, spark gap, helix and key. I use dry cells as a source of power for the transmitter. The aerial is 50 feet long and 40 feet high at one end and 50 feet at the other. The instruments are protected by fuses and a lightning switch. Very



Radio Set of J. Y. Parsons, Jr.

good results are obtained with this outfit.

J. Y. PARSONS, JR.
Kansas City, Mo.

Amateur News

Radio Club of America.

The Radio Club of America announces the election of the following officers for the year 1916: President, Edwin H. Armstrong; Vice President T. Johnson, Jr.; Treasurer, Ernest V. Amy; Corresponding Secretary, David S. Brown; Recording Secretary, Thomas J. Styles. Directors—Paul F. Godley, Alfred P. Morgan, Harry Sadenwater, Jos. A. Fried, Walter S. Lemmon. Office of the Secretary, 206 W. 86th St., New York City.

The annual election meeting of the club was on Saturday evening, January 8, at Columbia University.

Mr. William Dubilier presented a paper on "Portable Aeroplane and Trench Radio Sets." Special consideration was given to a type of apparatus developed by the author for utilizing direct currents in producing musical notes without the use of a motor generator set and revolving spark gaps. Mr. Dubilier described in detail, with lantern slides and apparatus, the installations now being used by the Allies for directing artillery fire, and communicating between trenches.

Central Radio Association News.

The membership of the Central Radio Association as shown by the supplemented Call Book is considerably in excess of one thousand. Amateurs of the better class are urged to request enrollment blanks of the secretary, H. B. Williams, at Chanute, Kans. No charge is made.

The new map of the C. R. A. is now ready for distribution. Copies may be obtained from Assistant Secretary S. Kruse at Lawrence, Kans.

All C. R. A. stations may be located on this map and the distance between any two rapidly and accurately determined.

Records of the Month: 9DM—H. C. Ziesenis, Lawrence, Kans., to Portsmouth, Va. Input, 1,000 watts. Distance, 1,250 miles. Time, night. 1.25 miles per watt.

Definition of the term "Record."—Transmission of connected matter over a distance in excess of one mile per watt input for night work or one mile per three watts input for daylight work shall constitute a record.

The Junior Radio Club, Pensacola, Fla.

The Junior Radio Club held its first meeting at the home of Edwin Copas, president, at which the following officers were elected: Edwin Copas, president; Oliver Williams, secretary; Fred Gillmore, operator. Every amateur is invited to join. Address all communications to Fred Gillmore, 127 W. Gregory St., Pensacola, Fla.

Wireless Station Built on University Campus.

A wireless station, which can receive messages from as far away as the government station at Radio Virginia, is being operated under the supervision of the physics department and the course in electrical engineering of the University of Wisconsin. Its aerial, which has a sweep of 140 feet, is 130 feet high and 15 feet wide, stretched from the chimney of one of the engineering buildings.

Time signals from the Arlington station at Washington are received twice every day and the report comes in very clear and strong. Although the apparatus is really an experiment, it is one of the best stations in the State.

Tampa, Fla., Wireless Enthusiasts.

Tampa, Fla., local amateur radio operators met at the Y. M. C. A. a short time ago and organized the Tampa Radio Club. Officers are: President, John Fogarty; vice-president, Victor McIlvaine; secretary-treasurer, Houston Wall.

The largest amateur station in Tampa is owned by Houston Wall. Other operators at the meeting were John Fogarty, Emilio Pons, Frank Cooper, Victor McIlvaine, Lamar Boyette, Livingstone Lesley, Leslie James, Harry Johnstone and Wesley Thaxton. The club requires that members shall be able to send and receive at least five words a minute.

Omaha Boy is World's Best Wireless Keyman.

A. R. Gerhard, of Omaha, Nebr., won the "champion wireless operator of the world" honor at the Panama-Pacific International Telegraphers' tournament, held recently at San Francisco. After winning this prize, he entered the "land" telegraphy department contest and took third honors.

Gerhard's home is at 2714 Jackson street. He learned wireless telegraphy by experimenting at his home. He has made several trans-Pacific trips as wireless operator.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

Wireless Course Popular at Loyola University.

Following the installation recently at Loyola University, New Orleans, La., of a powerful wireless station, interest in the course in wireless telegraphy has been steadily increasing. Classes are held three nights a week and a miniature sending and receiving apparatus is now in the course of construction in a large class room to be used for demonstration purposes.

Messages are being received from points 1,500 miles distant in South America, the United States station at Arlington and from stations on the Great Lakes and in Mexico. Prof. A. E. Porter is in charge of the class.

The Topeka Radio Club.

The Topeka Radio Club was organized a little over a year ago with a limited membership of twelve. The purpose of the club is to promote and regulate activities in and around Topeka, Kan. Six of the members have secured Government licenses and the whole club will be composed of licensed members in a short time.

The following officers have been elected for the year 1916: President, E. Broberg; vice-president, J. Keating; secretary and treasurer, W. Beasley; sergeant-at-arms, R. Morehouse.

All communications should be addressed to the secretary, Wm. A. Beasley, 1517 Western avenue, Topeka, Kan.

Radio Association of Long Island.

The Radio Association of Long Island was formed on Nov. 3, 1915. The following officers were elected for the ensuing year: President William Woolser; Vice-President and Secretary, Edwin Stewart; Treasurer, Charles Phelan; Librarian, George Coakley; Manager of the Operating Staff, Walter Davison.

The object of this association is to further the progress of radio communication over the whole of Long Island. The association will be glad to hear from any amateurs regarding any matter concerning this association. Address all communications to the Secretary, G. Edwin Stewart, 45 Hillside Ave., Rockville Center, L. I.

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK, TILL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of December, 1915. (Continued.)

SIXTH DISTRICT —(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
6ED	Farish, Edward T.	1609 W. Lewis St., San Diego, Cal.	.5
6FV	Foulon, Fred	423½ E. 29th St., Los Angeles, Cal.	1
6SF	Fuller, Sidney	1718 S. Main St., Los Angeles, Cal.	.5
6GN	Grossnicle, Russell R.	Lordsburg, Cal.	.5
6JO	Hayden, Jack	246 N. 22d Ave., Los Angeles, Cal.	.5
6PV	Henn, Charles W.	1468 47th Ave., San Francisco, Cal.	.5
6RK	Kelley, Roger M.	399 S. Wilson Ave., Pasadena, Cal.	.5
5VK	Kemp, Victor H.	803 E. 28th St., Los Angeles, Cal.	.5
6GT	Knudsen, George	418 Banks St., San Francisco, Cal.	.5
6HA	Kreamer, John A., Jr.	222 W. 33d St., Los Angeles, Cal.	.5
6LG	Lee, George R.	134 N. Johnstone St., Los Angeles	1
6JM	McCarger, J. L.	1413 16th St., Oakland, Cal.	1
6EM	McGuire, Edward	55 Dame St., San Francisco, Cal.	.5
6WN	McKinzie, Wm. H.	664 11th St., Oakland, Cal.	.5
6PR	Murkett, Philip T.	126 W. Olive Ave., Redlands, Cal.	.5
6HM	Murphy, Harold J.	Mountain View, Cal.	.5
6TA	Nelk, Teddy J.	848 E. 28th St., Los Angeles, Cal.	.5
6AG	Neuser, Arthur A.	280 N. 22d Ave., Los Angeles, Cal.	.5
6FP	Parke, Francis M.	582 N. Park Ave., Pomona, Cal.	.5
6CM	Phillips, Carroll J.	1261 St. Charles St., Alameda, Cal.	.5
6EX	Remelin, Eldred L.	Perris, Cal.	.5
6FR	Salome, Drederic W.	1493 Harrison St., Oakland, Cal.	.5
6HS	Schnarr, Henry J.	3611 Allendale Ave., Oakland, Cal.	.5
6AY	Schneider, August G.	530 S. Chicago St., Los Angeles, Cal.	.5
6SM	Smith, Seth	78 Peralta Ave., San Francisco, Cal.	.5
6WR	Spare, Wilson	3737 3d St., San Diego, Cal.	.5
6RE	Stoddard, Harold	1309 8th St., Oakland, Cal.	.5
6JU	Tait, Jack D.	1264 Oxford St., Los Angeles, Cal.	.5
6WA	Van Why, Forbes W.	2012 N. Broadway, Los Angeles, Cal.	1
6WO	Walters, Wilbur E.	410 E. 2d St., Lordsburg, Cal.	.5
6NW	Webb, Morrison R.	541 18th St., Oakland, Cal.	.5
6DX	Wheelock, Chas.	143 N. Lime St., Riverside, Cal.	.5
6HW	White, Howard	822 E. 4th St., Santa Ana, Cal.	.5

SEVENTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
7CQ	Christianson, Herbert	112 W. Poplar St., N. Yakima, Wash.	.5
7NC	Clodfelter, Nolan A.	1221 E. Madison St., Portland, Oreg.	.5
7DI	Goodger, Donnan P.	4214 Interlake Ave., Seattle, Wash.	.5
7GF	Gibbs, Francks F.	512 E. 4th St., Hood River, Oreg.	.5
7GO	Hagen, Bert W. R.	217 N. Miles Av., N. Yakima, Wash.	.5
7HQ	Hayden, Henry T., Jr.	Port Townsend, Wash.	.5
7FQ	Lewis, Harold H.	R. F. D. No. 2, Lewiston, Idaho	.5
7GL	Manca, Angelo C.	1816 E. Jefferson St., Seattle, Wash.	.5
7NS	Sanborn, Ned	501 M. St., Hoquiam, Wash.	.5
7SC	Sparks, A. Eldon	1029 Walnut St., Baker, Oreg.	.5
7VN	Van Olinda, Oliver S.	R. F. D. No. 1, Vashon, Wash.	1
7WA	White, Ruel	313 W. 4th St., Vancouver, Wash.	1

EIGHTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
8RS	Alger, Allan E.	214 Arizona Ave., Lorain, Ohio	1
8AMJ	Allan, Donald	3237 Dayton Ave., Cincinnati, O.	.5
8ML	Berman, Isidore A.	849 Windham St., Cincinnati, Ohio.	.5
8ANB	Bower, Stanley	162 Elizabeth St., Marine City, Mich	.5
8AJ	Custis, Walter E.	468 Buchtel Ave., Akron, Ohio	.5
8CI	Danforth, Gordon F.	16 Tuxill Sq., Auburn, N. Y.	.5
8FP	Esslinger, Elwin	523 Miller Ave., Ann Arbor, Mich.	1
8SB	Evans, George M.	Tippecanoe City, Ohio	.5
8DD	Fleckner, Harry K.	1007 Sheridan Ave., S. W., Grand Rapids, Mich.	.5
8ANF	Frase, Ralph L.	546 E. Buchtel Ave., Akron, Ohio	.5
8HE	Grotticelli, Emil	115 Montclair Ave., Grafton, Pa.	1
8ANC	Israel, Dorman	3426 Burnet Ave., Cincinnati, O.	.5
8PU	Jones, Winferd E.	87 Holland Ave., Lancaster, N. Y.	.5
8LF	Loebs, George	1139 St. Paul St., Rochester, N. Y.	.5
8ND	McCarty, Alison	38 Morgan St., Oberlin, Ohio	.5
8SC	Marshall, Leonard A.	2234 Putnam St., Toledo, Ohio	.5

EIGHTH DISTRICT (Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
8WL	O'Leary, Hilary	Montclair St. and Stratford Ave., Crafton, Pa.	1
8DL	Osterbrock, Ed. and H., Jr.	4152 Webster Ave., Norwood, Ohio.	.5
8SO	Preston, Menzo D.	424 E. Main St., Wellington, Ohio.	.5
8ANE	Russell, Fred W.	909 Kensington Ave., S. W., Grand Rapids, Mich.	.5
8ANI	Seidel, Frank	1357 Tennessee Ave., Dormont, Pa.	.5
8QO	Smith, Grant A.	408 Jay St., St. Clair, Mich.	.5
8BU	Stellrecht, Howard	15 Clark St., Lancaster, N. Y.	.5
8ANH	Stewart, Donald G.	2235 Putnam St., Toledo, Ohio	.5
8KY	Thomas, Earl R.	712 Louisa St., Williamsport, Pa.	.5
8AND	Thurnes, Darley	187 W. Chestnut St., Akron, Ohio	.5
8RT	Toy, Miles N.	121½ W. Market St., Lima, Ohio	1
8QT	Watson, Jas. G.	108 Maple Ave., Cincinnati, Ohio	.5
8EQ	Weekman, Frank L. and Verne W.	115 Weeks St., Jamestown, N. Y.	.5
8ADF	Werner, Herman E.	41 Fay St., Akron, Ohio	.5
8RQ	Wescott, Alva F.	Ashville, N. Y.	1
8AIN	Williams, John C.	60 Hollister St., Cincinnati, Ohio.	.5
8ANG	Wright, Harry D., Jr.	1116 W. Market St., Lima, Ohio	.5

NINTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
9JJ	Alvested, Clarence M.	819 13th Ave., S. Minneapolis, Minn.	.5
9HA	Andrew, Warren	Boulder, Colo.	.5
9CL	Beech, Guy L.	Clarinda, Iowa	.5
9KS	Bennett, Harold	Clarinda, Iowa	.5
9WQ	Black, Harry N.	Independence, Iowa	.5
9CT	Brailsford, Harry D.	323 W. Broadway, Louisville, Ky.	.5
9KJ	Briggs, Walter C.	4525 Dupont Ave., S., Minneapolis, Minn.	.5
9WR	Burghardt, R. Douglas	5023 N. 24th St., Omaha, Nebr.	.5
9WU	Church, Arthur B.	Lamoni, Iowa	1
9DD	Ederer, Lothar A.	6347 Kenmore Ave., Chicago, Ill.	1
9JX	Griffiths, Robert E.	4704 Fulton St., Chicago, Ill.	.5
9CH	Grosscupt, Harry W.	3746 Giddings St., Chicago, Ill.	.5
9JO	Gustafson, Gerald	214 Crawford St., Boone, Iowa	.5
9BF	Heck, Lawrence F.	1239 Center St., Racine, Wis.	.5
9CW	Heise, Elmer B.	513½ Franklin St., Michigan City, Ind.	.5
9WV	Hoffman, Erich A.	819 Laramie St., Atchison, Kans.	1
9CV	Johnston, Roderick E.	Boulder, Colo.	.5
9IB	Koch, Emerson L.	3032 E. Michigan St., Indianapolis, Ind.	.5
9WT	Kelley, Edward L.	551 Parkside Ave., Chicago, Ill.	.5
9JC	Lewis, W. Turner, Jr.	1500 Main St., Racine, Wis.	1
9BO	McBride, Ralph M.	Tabor, Iowa	.5
9AE	McGee, Paul J.	2609 Richmond Ave., Mattoon, Ill.	.5
9OT	McKee, Charles R.	203 N. 2d St., Atchison, Kans.	1
9WP	McKeever, Thomas	1703 W. 104th Pl., Chicago, Ill.	.5
9DW	Malott, Alfred F.	945 W. 30th St., Indianapolis, Ind.	.5
9CO	Maupin, Ross T.	2436 Indiana St., Kansas City, Mo.	.5
9AJ	Nell, Raymond B.	Clinton, Iowa	.5
9WS	Patterson, Coy V.	3528 Winsor Ave., Kansas City, Mo.	.5
9BL	Perl, Raymond H.	2533 N. Richmond St., Chicago, Ill.	1
9HU	Pilgram, G. W. & John C.	710 S. 19th St., St. Joseph, Mo.	.5
9SQ	Rea, Richard S.	1028 Prospect St., Elgin, Ill.	.5
9AT	Rueschau, Harry R.	3748 Clifton Ave., Chicago, Ill.	1
9OP	Sandifer, Robert P.	325 N. Atchison St., El Dorado, Kas.	.5
9KV	Sauer, August	809 N. Temple Ave., Indianapolis, Ind.	.5
9DZ	Seaman, Walter A.	734 Christiana Ave., Chicago, Ill.	.5
9HP	Stevens, Kenneth	2032 N. 7th St., Sheboygan, Wis.	.5
9AA	Stone, Richard G.	717 Douglas Ave., Elgin, Ill.	.5
9IH	Talbott, Edward	1114 W. 34th St., Indianapolis, Ind.	1
9WV	Wireless Trio, The	(See Hoffman, Erich A.)	

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of January, 1916.

FIRST DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
1ANH	Aldrich, George E.	9 Simonds Rd., Melrose, Mass.	.5
1JL	Ayres, Richard T.	10 Common St., Charlestown, Mass	.5
1ANB	Bacuinka, Peter L.	137 Dorchester St., Worcester, Mass	.5
1ANJ	Bailey, Charles E.	51 Chestnut St., New Britain, Conn.	.5
1AED	Beebe, William J.	42 Ridgewood Pl., Springfield, Mass	.5
1KJ	Blake, Sidney S.	25 Elm St., Westerly, R. I.	.5
1VH	Bollerer, Alexander V.	77 Linwood St., New Britain, Conn.	.5
1AEJ	Bradshaw, Wesley B.	16 Centre St., New London, Conn.	.5
1ANT	Buck, Richard C.	44 Linden St., Reading, Mass.	.5
1RC	Chase, Frank H.	55 Washington Ave., Chelsea, Mass.	.5
1AEG	Cornwell, Wm. J.	24 Clark St., Cambridge, Mass.	.5
1AEY	Cross, Leon F.	3 Vine St., Tilton, N. H.	.5
1ANU	Davis, Clifton D.	8 Cedar Court, Wakefield, Mass.	.5
1AEZ	Daynes, Frederick A.	380 E. St., South Boston, Mass.	.5
1AEA	de Mars, Paul A.	43 Vine St., Lawrence, Mass.	.5
1AEE	Dickson, Wm. E.	59 Camden Circle, Quincy, Mass.	.5
1AER	Entwistle, Guy R.	Everett, Mass.	.5
1ANI	Erwin, Wm. C.	50 Beechwood Ave., Watertown, Mass.	.5
1ANF	Fay, Arthur N.	257 B'way, Chicopee Falls, Mass.	1
1AEB	Flint, Arthur W.	4 Green St., Wakefield, Mass.	1
1ANA	George, Eldridge B.	211 Arsenal St., Watertown, Mass.	.5
1AEF	Gilman, Samuel	63 Chestnut St., Chelsea, Mass.	.5
1ANG	Godfrey, Warren	117 Park St., West Roxbury, Mass.	.5
1AEH	Halligan, Wm. J.	23 Devens St., Charlestown, Mass.	.5
1AF	Hart, Emery A.	80 Melborne St., Portland, Me.	.5
1AEV	Hayden, Kenneth L.	44 Chester Ave., Winthrop, Mass.	—
1ANN	Holbrook, Frank L.	36 Moody St., Portland, Me.	.5
1AET	Holmes, Phillip B.	21 Rocklegde Rd., Newton Highlands, Mass.	.5
1AEP	Hunkins, Fred L.	17 Center St., Laconia, N. H.	.5
1AEM	Johnson, Gilbert W.	75 Ontario St., Providence, R. I.	.5
1ANK	Kurth, Henry L. R.	126 Columbia St., Cambridge, Mass	.5
1WR	Lane, Chauncey C.	73 S. Water St., New Haven, Conn.	.5
1ANL	Leonard, James A.	30 Newhall St., Lynn, Mass.	.5
1AAR	Lewis, Wm. H., Jr.	226 Upland Rd., Cambridge, Mass.	.5
1SP	Lisker, Wm.	141 Chester Ave., Providence, R. I.	.5

FIRST DISTRICT—(Cont'd.)

Call signal	Owner of station	Location of station	Power kilowatts.
1AEL	Little, Noel C.	8 College St., Brunswick, Me.	.5
1ANE	Lyman, Edward W.	25 Pine St., Pittsfield, Mass.	.5
1BP	Mills, Bruce M.	48 Crescent St., Rutland, Vt.	.5
1AEX	Mosher, Albert E.	35 Forest St., Lawrence, Mass.	.5
1ANO	Osborne, Roger W.	15 Olney Pl., East Lynn, Mass.	.5
1GN	Palmer, Chas. A.	57 Wollaston Ave., Arlington Hts., Mass.	.5
1BY	Parker, Leighland F.	Island Pond, Vt.	1
1EN	Pierce, Fred'k H.	High School Bldg., Lewiston, Me.	1
1AMB	Pratt, Phinehas W.	100 Harvard St., Everett, Mass.	.5
1AEO	Redfield, Kendall A.	18 Mace Pl., Lynn, Mass.	.5
1AEI	St. John, Forbes	Darien, Conn.	.5
1IN	Schwartz, Walter P.	3 Thatcher St., Hyde Park, Mass.	.5
1ANM	Senior, Wm. B.	68 Mechanic St., Westerly, R. I.	.5
1AEQ	Shaw, Arthur M.	49 Washington Blvd., Springfield, Mass.	.5
1AL	Sinnett, Chester M.	Bailey Island, Me.	.5
1AEK	Sleeper, Joseph N.	Sanbornton, N. H.	—
1AEU	Southworth, Arthur P.	122 Chestnut St., Wakefield, Mass.	.5
1AES	Stone, Perry	15 West St., New London, Conn.	.5
1ANS	Stoughton, Edgecombe	198 Ocean Ave., Portland, Me.	.5
1AC	Stubbs, Edward T.	1 Bennett St., Sanford, Me.	.5
1HD	Sullivan, John F.	485 E. 6th St., S. Boston, Mass.	.5
1GQ	Thompson, John E.	3 Grand St., Reading, Mass.	.5
1KO	Upham, Howard B.	20 Mt. Bowdoin Ter., Boston, Mass.	.5
1ABW	Whitcomb, Raymond E.	12 Gerry St., Stoneham, Mass.	.5
1AG	Wilbur, Harold S.	R. F. D. No. 6, Auburn, Me.	.5
1AEN	Winstanley, Robert	22 Battery St., Boston, Mass.	.5
1AEW	Whittaker, Laban H.	38 Corona St., Dorchester, Mass.	.5

SECOND DISTRICT.

Call signal	Owner of station	Location of station	Power kilowatts.
2AIX	Ballentine, Harold E.	17 Sharp Ave., Pt. Richmond, N. Y.	.5
2AIF	Betts, Philadner H.	Montclair, N. J.	.5
2AII	Brewster, Carleton, Jr.	2 Ocean Ave., Bay Shore, N. Y.	.5
2AJF	Broome, Frank H.	315 Chestnut St., Roselle Pk., N. J.	1
2AID	Butler, Robert M.	396 E. 16th St., B'klyn, N. Y.	.5
2AJC	Carr, John	204 W. 149th St., New York, N. Y.	.5

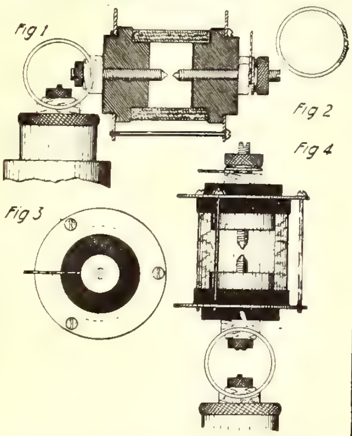
(To be continued)

LATEST PATENTS

Intensifier for Spark-Plugs.

(No. 1,169,744; issued to Alexis F. Gillet, assignor to Jubilee Manufacturing Company.)

This device is intended to pile up

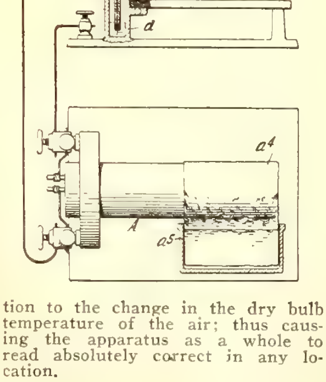


the secondary surges in a gasoline engine spark coil ignition circuit, and in this way to create a much fatter and more powerful discharge at the inner gap electrodes of the spark plug than is procurable otherwise. The intensifier is attachable, as perceived, to the upper binding post of the spark plug.

A Thermo-Electric Humidity Instrument.

(No. 1,169,617; issued to Edward W. Comfort, assignor to Buffalo Forge Company.)

A new design of thermo-electric humidity instrument which compensates itself for changes in temperature and the corresponding effects on the electric circuit. It includes a compound thermo-electric battery A, which has proper absorbing members a4 dipping into some water at a5. A galvanometer calibrated to read degrees of humidity is shown at B, while at E and D are shown respectively the thermic-motor and rheostat. This motor in turning the shaft d4 a short way about its axis, causes the rheostat wheel d1 to dip more or less of its points into a mercury bath d. The thermic-motor and rheostat arrangement is for the purpose of altering the current in the circuit in propor-

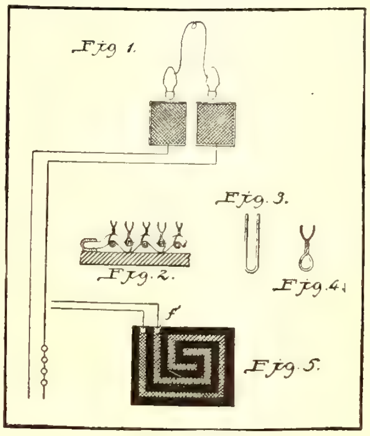


tion to the change in the dry bulb temperature of the air; thus causing the apparatus as a whole to read absolutely correct in any location.

Electrical Dancing Mat.

(No. 1,178,444; issued to Stephen Goldini.)

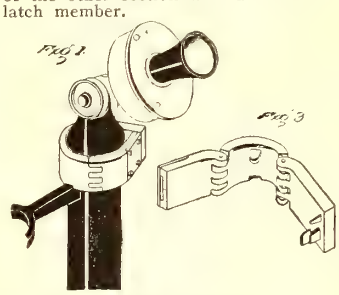
An electric spark-producing dancing mat for either A.C. or D.C. circuits. This invention embodies a mat or mats on which the dancer treads, the tread surface of which mat is provided with a plurality of upstanding wires on which the artist treads during the act of dancing. These upstanding wires of the one or more mats are electrically connected with a source of electrical current, either direct or alternating, so that, when an operator treads upon the surface of the mat with metallic-soled shoes, a circuit is completed, with the result that electric flashes are produced.



Telephone Lock.

(No. 1,172,614; issued to John E. Lavalley.)

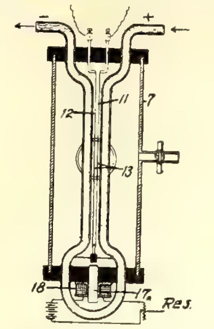
The object of this invention consists in constructing a device for locking telephones and to be made in the form of a collar adapted to embrace the standard of the instrument. Further, the collar includes a number of sections hingedly connected. The collar is provided at the free end of one section with a lock mechanism and the free end of the other section with a hook or latch member.



Electro-magnetic Indicator.

(No. 1,172,018; issued to Reginald A. Fessenden, assignor to Samuel M. Kintner and Halsey M. Barrett.)

This apparatus is of the string galvanometer type. The field conductors are kept especially cool, so that very heavy currents may be passed through the instrument as by passing liquid air through such conductors, which, of course, are made hollow for the purpose set forth. Several hundred amperes may be passed through this instrument. The inclosing vessel 7 is preferably vacuous. The tension on the looped conductor 11 and 12 is variable by a D.C. excited magnetic tension-control 17 and 18, connected up with a battery and rheostat, as perceived. A beam of light is passed crosswise through the chamber 7, which contains proper openings, and any movement of the enlarged portions of the looped conductor as at 13, is thus thrown on a scale or other apparatus and its various configurations there noted (visually or photographically). This instrument has

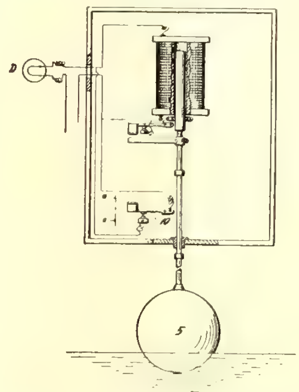


a very small time period owing to the unique design involved.

Electric Water Lever Indicator

(No. 1,171,405; issued by Dave Ablon.)

An ingenious design of water lever indicator, whereby an incandescent lamp D, is made to glow at different degrees of brilliancy ac-

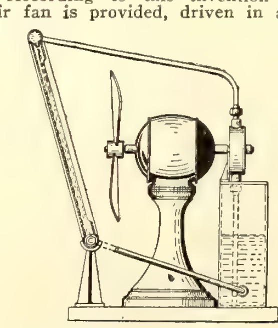


cording to the depth of water in the tank, which in turn causes a float 5 to rise and fall proportionately. When the float is at its lowest extremity, it closes a switch 10 causing the lamp D to burn directly on the A.C. service mains. As the water, and conjointly the float 5 rise, the iron core attached to the upper end of same extends farther within the solenoid winding, thus creating more impedance and in consequence the lamp D grows dimmer in proportion. A trip switch is actuated when the float and its vertical shaft 6 have reached the upper limit of their movement which opens the solenoid circuit.

Air Cooling and Aromatizing Fan.

(No. 1,173,497; issued to John Farley.)

According to this invention an air fan is provided, driven in any

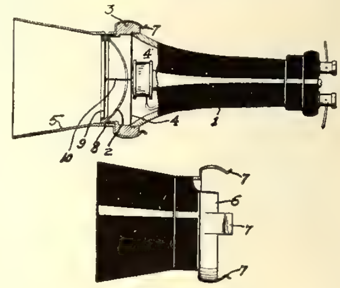


suitable manner, say by an electric motor, and mounted in front of the fan, in such manner that the air from the fan is driven therethrough, is a grid or the like device made of a series of tubes or ducts, the sides of which nearest the fan are open, or the tubes may be perforated. Means are provided for causing a circulation of water or other liquid to take place through the tubes of the grid. The liquid may be merely water for the purpose of cooling the air and entrapping dust and fiber which is then carried away in the water flow, or water impregnated with disinfectants or perfume.

Telephonic Amplifier.

(No. 1,179,117; issued to Emily D. Lowry.)

An amplifier intended for use on ordinary telephone receivers, en-

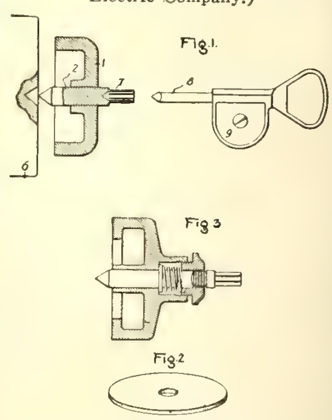


abling the user to lay the receiver on the table, thus leaving both hands free.

The mechanism comprises the usual telephone receiver 1 having the cup 2 with the ring 3 thereon and the diaphragm 4 thereon, in combination with the sound tube 5 having the rim 6. This telescopes on the ring 3; the spring clips 7 engage the ring to hold the rim in place; the ring 8 screws into the tube. The auxiliary diaphragm 9 is carried by the ring 8, and the pin or strut 10 is fixed to the center of the auxiliary diaphragm.

Magnetic Connector for Speed Indicator.

(No. 1,168,037; issued to Frank Short, assignor to General Electric Company.)



This scheme utilizes the principle of magnetism to provide a neat and handy attachment which will hold an ordinary speed indicator or counter in position on the end of a rotating shaft 6. The cup-shaped member 1, is made of steel strongly magnetized and the center stem 2 is also of steel and made to slide quite snugly through the opening in cup 1. A spring chuck 7 makes firm connection with the stem of the speed indicator 8. The weight of the indicator part at 9, ordinarily will keep this portion of the instrument stationary while the template revolves. An alternative design is shown at Fig. 3, while 2 is a soft iron plate acting as a "keeper" for preserving the magnetism in the steel shell 1 when it is not in use.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 !! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

ALEC TRICITY, OF OYSTER-ON-THE-½-SHELL BAY.

FAT MAN'S JOY

Me4u
4-1

Specifications of Patent Leathers.

(Patented Black Friday 13th)

To whomsoever it may concern, consarn you:

By the knowledge of the fact that I, Alec Tricity, a spifflicated native of Oyster-on-the-½-shell-Bay, have, in spite of constant danger from the indiscriminate wielding of the Big Stick, succeeded in constructing a machine which will either kill or cure—probably the former—all men who are inclined toward stoutness, due to their having sat too long at the little round tables, guzzling the soapy foam from a growler of Pilsener's best dark brown, or to their eating too many portions of steak and onions, as well as other frightful fat foods.

This invention relates to a mechanical means for muscle mutilation, which positively reduces the proboscity of any person.

The action of this device is as follows: The patient, victim, or otherwise, stretches the noble proportions of his sylph-like figure upon the cold, hard plate, 26, with his painfully prominent protuberance pointing toward the Pole star. His dainty, naked feet are held by the strap 27, while a brass band—no connection with a German Band—passes lightly over his manly chest. 3 is a shaft supported by inlaid mahogany hangers, 18, and driven by the motor 4, belt 19 and pulley 20. Current is supplied by wire 30, with switch 29. When revolving, the shaft causes rod 9 and plate 2, too, to move with a gentle, undulating un-adulterated movement, which, as it exerts a soothing pressure, makes the fortunate patient writhe with glee, while the salty tears spring to his docile, cow-like eyes.

In the meantime, connector 8, joined to crank 31, moves the arms up and down, thus reducing the fatty accumulation, caused by too great unfamiliarity with the use of Shank's Mare. 5 is a spark coil, connected to battery 6. The secondary current, applied through shaft 3 and the connecting rods, keeps the patient in a happy flutter of enjoyment. In the meantime, the wheel 15, which carries a contact 16, operates a magnet, 13, actuated by battery 7. The armature 12, governed by spring 14 regularly opens the valve of a spraying device, 10, blowing a zephyry shower of pre-digested onion emulsion on the red and bulbous nose of the treated person.

A little, or chicken feather, 25, fastened to wheel 24, is run by the gears 21 and 22, supported by hangers 23. This actuates the tickling membrane at the bottom of the pedal extremities, thus keeping the patient in an amiable mood. It is highly important that only chicken feathers be used. Patients using this device are notoriously known to be "chicken" fanciers. Hens feathers would never do.

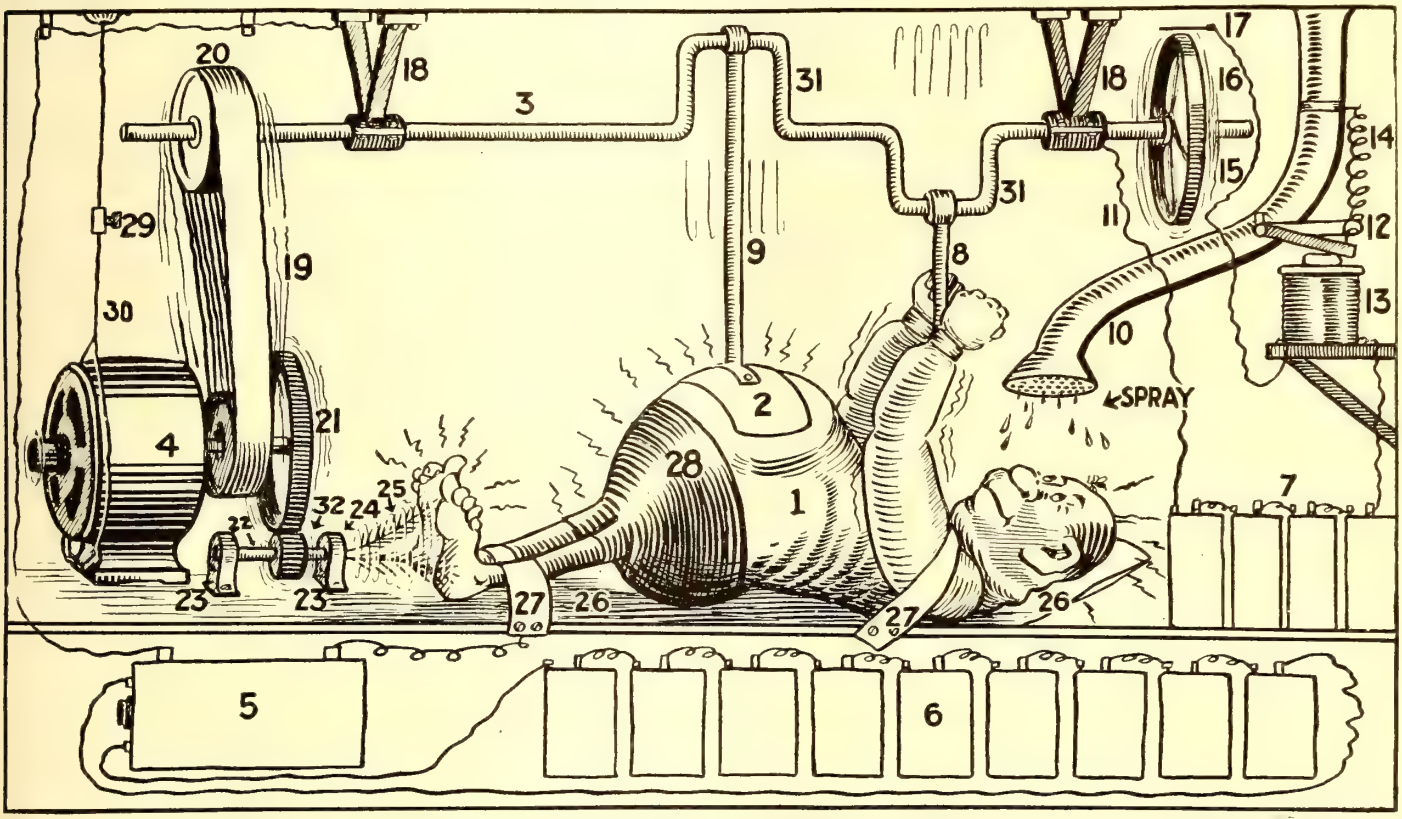
What I claim is:

1. A device which will positively cure or bust any abnormality in the region of the solar plexus.
2. A device which, while reducing the fatty degeneration, will give the victim the most powerfully pleasant prodding and poking which he ever experienced, and leave him in such a condition that he will never be able to look cross-eyed at a man's-size portion of baked beans or pigs' knuckles with sauerkraut.
3. A device which will make money in Turkish, Russian and Skowhegan baths, where all-night rounders usually finish up to sweat out their remorse at losing twenty-nine cents in a gum machine which didn't work.
4. A device which will actually perform the work of the usual Anti-Fat, Don't-be-Thin, or Have-Muscles-and-Perfect-Figure-Like-Mine preparations, which never cure, and kill much slower than this mechanical anti-fatter. There is no question about kicking the bucket with this device.

In testimony whereat I put my name, during the third year since our cat swallowed a clothes-pin, and died of hokus-pokusmorphia, on the back steps, with its left hind foot still in position to scratch the flea which it never could find.

ALEC TRICITY,
By his attorney,
Harry Haenigsen.

Witnesses:
Will U. Diet.
O. I. Shudworra.
Lemme Bust.



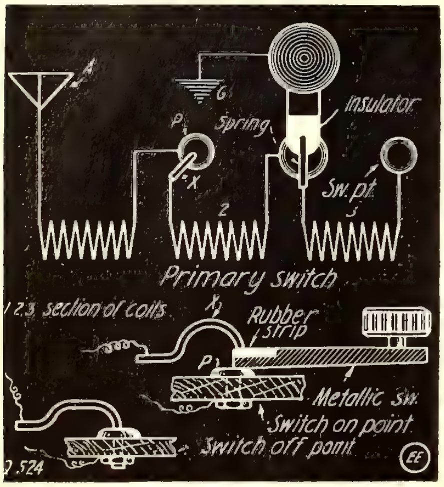
An Anti-Fatter, in which the Parabolic Protuberance is Positively Compressed by a Stomach Plate, operated by a Crank, while the Auxiliary Processes Proceed

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

Telephone Magneto.

(524.) Matt Jarosz, Chicago, Ill., asks: 1. Can the back E.M.F. of a series wound motor be used for sending in wireless telegraphy? 2. Can you give me a diagram showing how a dead-end switch is connected in a navy type loose-coupler? 3. Can a telephone magneto having four magnets be changed into a shunt wound dynamo for charging batteries.



Dead-End Elimination Switch for Loose Couplers.

A. 1. The back E.M.F. (voltage) of a series wound motor can not be used in any way for operating the sending coil in wireless telegraphy as we do not know any means of utilizing this back E.M.F. for such a purpose.

A. 2. The illustration herewith gives the connections of a very good dead-end switch which is used for the primary but a similar one can be made for the secondary coil.

A. 3. A telephone magneto can not be changed into a shunt wound dynamo very easily, but if field coils are wound over the magnets and so connected that the polarity of same does not change the polarity of the permanent magnets, it would be possible to convert this magneto into a shunt wound dynamo. A commutator will have to be added to the armature.

Audio-Tron Bulbs.

(524-A.) John Eddy, Jr., N.Y., writes: 1. Are the Audio-tron bulbs as advertised in the March issue of *The Electrical Experimenter* as sensitive as audion detectors and can they be used in the reception of undamped waves, using the "beat" system? 2. Are any other additional instruments required for detecting these continuous waves besides the audio-tron tube? 3. What are the requirements for membership in the Wireless Association of America?

A. 1. These bulbs are somewhat more sensitive than the audion because of the greater ionic generating surface obtained which is due to the increase of size of the grid and wing. These detectors are suitable for the reception of undamped waves when used in proper oscillating circuits such as the Armstrong type.

A. 2. The only instruments that will be required for operating this detector for receiving undamped waves are additional inductances and capacities properly connected. Refer to recent issues of this journal.

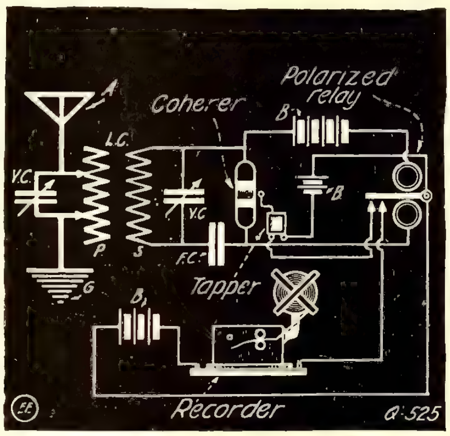
A. 3. This organization is no longer in existence.

Carbon Ball Transmitter.

(525.) F. Howell Miller, Richmond Hill, N.Y., writes: 1. Kindly give the connections for a coherer so that I can operate a tape recorder. 2. What is the price and where can a carbon ball transmitter be obtained, such as is used in the Electro-Magnet Skull described in the March, 1916, issue of *The Electrical Experimenter?*

A. 1. Herewith is given a diagram of the connections for a coherer operating a recorder.

A. 2. A suitable transmitter may be purchased from The Electro Importing Co., 233 Fulton Street, New York City. Although this transmitter is not exactly like



Coherer Wiring Diagram, Including Tape Register.

the one described in the magazine, it will do the same work and is very sensitive, which is the most important point in the construction of the magic skull.

20,000 Meter Tuner.

(526.) Morris Klosner, Bronx, N.Y., inquires: 1. Will you please give me the constructional details of a loose coupler that will receive wave lengths of 20,000 meters and that can be adjusted without sliders or switches and have two primaries and two secondaries? 2. Is this loose coupler more efficient than a standard type coupler?

A. 1. The primary tubes are both 14 inches long, and 12 inches and 11½ inches in diameter, wound with No. 20 s.s.c. wire. The secondary coils are 13 inches long, by 11 inches and 10½ inches in diameter, wound with No. 24 s.s. wire. The primary coils and secondary coils are connected in series, so that their inductances oppose each other.

A. 2. The 20,000 meter coupler is not as efficient as the standard type for all around work, but the former is by far the most efficient instrument for receiving long wave stations.

A large loose coupler is always more efficient than a small coupler used with a loading coil. Such auxiliary inductances are a source of loss in any event.

Small Tesla Coil.

(527.) Stanley R. Booth, W. Va., asks: 1. Is it possible to operate a small Tesla transformer coil on a ½-inch spark coil and electrolytic interrupter? 2. What would be the dimensions for this Tesla coil? 3. About what length spark could be drawn from such an apparatus?

A. 1. A small Tesla transformer can be operated by a ½-inch spark coil and an electrolytic interrupter on 110 volts, A.C. or D.C.

A. 2. It can be constructed with a primary 3 inches long by 3 inches in diameter and a secondary 6 inches long and 2 inches in diameter. The primary should be wound with No. 18 B. & S. rubber-covered copper wire and the secondary with No. 28 B. & S. copper magnet wire.

A. 3. You would probably be able to obtain 1½ to 2 inch sparks from this coil.

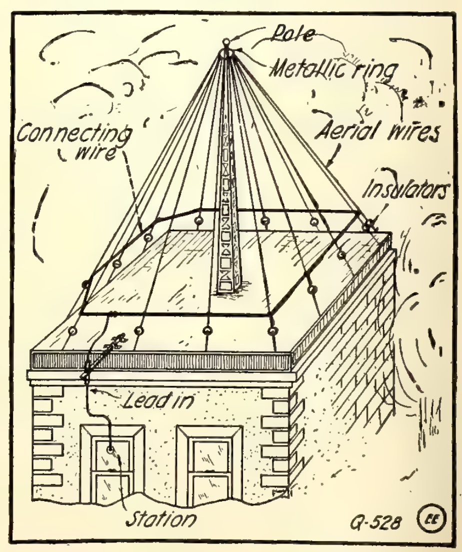
Umbrella Aerial.

(528.) Stanley E. Perezs, Havana, Cuba, writes: 1. What is the wave length of a 3 slide tuner, wound with 365 feet of No. 24 B. & S. bare copper wire? 2. What is the receiving distance of a set with a 3 slide tuner, galena and silicon detectors, two tubular condensers, rotary variable condenser and an umbrella aerial 36 feet high and 36 feet long composed of 12 wires? 3. Which is the most efficient way of connecting an umbrella aerial?

A. 1. The maximum wave length that you can obtain by using this tuner is about 1,200 meters.

A. 2. You should have no trouble in receiving 500 miles.

A. 3. The illustration herewith gives the



Umbrella Aerial Arrangement.

connections of a suitable umbrella type antenna.

(*Continued on page 118*)

QUESTION BOX.
(Continued from page 116)

Dynamo Troubles.

(529.) Eugene S. Bee, Miss., asks: 1. Why will my motor generator not develop current when it runs all right as a motor?

A. 1. We would advise you to excite the generator field from some source of current and at the same time run the machine. If you do not obtain any results after exciting the field in this manner, the only other thing to do is to reverse the field connection. In one of these ways you will no doubt get the machine to develop the proper amount of current, if it is not burned out. Test your armature coils and commutator.

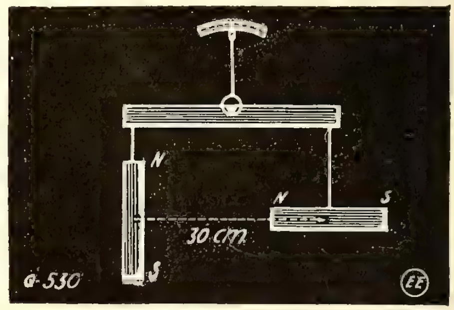
2. Should a ground wire be insulated from the house structure when it is lead to earth? 3. What is the maximum wave length of the receiving transformer which I have described?

A. 2. It is not necessary for you to insulate the ground wire when leading it to the ground terminal; no insulators should be used.

A. 3. About ,500 meters.

A MAGNETIC PROBLEM.

(530.) Jacob Fossauer, Brooklyn, N.Y., wishes us to solve three problems for him.



Will the Attraction Between the Two Magnets Unbalance the Scale Beam?

Q. 1. Two magnets 1 cm. x ½ cm. x 30 cm. long magnetized to an intensity of 700 units pole per square cm. of sectional area are hung from a balance beam as indicated in Fig. 1. Assuming that the magnets exactly balance each other before they are magnetized, find the number of grams which must be added to one pan to balance the magnets after they are magnetized and specify to which pan it must be added.

A. 1. In order to put the pan in equilibrium again, it will be necessary to add .715 grams to the left pan after the magnets have been magnetized.

Q. 2. A horizontal electric light wire stretched due magnetic north and south carries 1,000 amperes of current flowing toward the north. The length of the wire

is 250 meters, the intensity of the earth's field is .57 gauss and the magnetic dip is 63°. Find the value of the force pushing on the wire and specify the direction.

A. 2. In this problem the amount of force pushing on the wire is 1,269,500 dynes and the direction is west.

Q. 3. The choke coil of a lightning arrester consists of 50 turns of wire wound in one layer and on a cylinder of which the diameter is 15 cm. and the length is 50 cm. (a) Calculate the approximate inductance of this coil. (b) Calculate the approximate rate of increase of current in the coil at the instant that a lightning discharge jumps across 2 cm. of air in preference to going through the coil.

A. 3. The inductance of the coil described in the third problem is .000111 henry. The amount of current produced by the lightning discharge at instantaneous value is 360,000,000 amperes.

CHOKE COIL.

(531.) Joseph Spencer, Delaware, wants us to give him the dimensions for building a choke coil for an arc used in radiotelegraphy.

A. 1. It is impossible for us to give you dimensions for a choke coil unless the power of the arc is specified.

Q. 2. Can alternating current be used for a radio arc?

A. 2. Alternating current can be used for a radio arc, providing a step-up transformer is employed.

Q. 3. What are the best materials to use for the arc electrode?

A. 3. Carbon and copper electrodes have been found the best to use in constructing the arc generator.

WAVE-LENGTH.

(532.) Clyde Stewart, Wisconsin, inquires:

Q. 1. Will a helix increase the wave length of a sending station; if so, how much?

A. 1. A helix will increase the wave length of a sending station, but it is impossible to say how much, as it is necessary to know first the size of the helix and aerial used.

Q. 2. Will an arc send as far as a transformer on the same amount of current?

A. 2. An arc will not send as far as a transformer on the same amount of current, unless the arc is supplied with upwards of 2 K.W. of power and even in this case it is hard to say whether the arc will send as far as a transformer of the same rating, but arcs that use power above 50 K.W. will usually send further than transformers of the conventional type.

Q. 3. Will the current from a transformer coil kill a person?

A. 3. Whether such a coil will kill a person depends upon the size of the coil and also the manner in which the person is shocked. Some people will stand shocks much better than others. It also depends upon the physical condition of the person that receives the electric current, moisture of hands, etc.

COIL FORMULAE.

(533.) W. Grimshaw, Akron, Ohio, wants to know the correct formula for determining the wave-length of a specified coil.

A. 1. The formula which you desire is herewith given:

$$W.L. = \frac{\pi\ (3.1416) \times d \times t \times L \times 4}{3.28}$$

Where:— W.L.=Wave Length in Meters.
d=Diameter of coil in feet.
t=Number of turns of wire per inch.
L=Length of coil in inches.

This result is only approximate.

The wave length of any coil is depend-

(Continued on page 121)

QUESTION BOX

(*Continued from page 119*)

ent upon its inductance and (inherent) distributed capacity. The latter is small in most cases and is ignored in figuring these tuning coils as a component of compound oscillating circuits, as for instance, when a coil is connected in series with an aerial. The capacity and inductance of the aerial and lead-in are calculated and to these quantities is added the inductance of the tuning coil.

The inductance of a coil in henries may be found by connecting it up in series with an ammeter on an A.C. circuit. A voltmeter is connected across the coil, and a frequency meter shunts the feed lines. Then, knowing R, the ohmic resistance of the coil; E, the effective volts across the coil; I, the effective current in amperes traversing the coil and F the frequency in cycles per second as indicated on the frequency meter, the inductance L, in henries, is found by the formula:

$$L = \frac{1}{2\pi f}\sqrt{\frac{E^2 - I^2R^2}{I^2}};$$

where $\pi = 3.1416$, a constant.

There is a host of formulae available for calculating the inductance of coils but the majority of them are not accurate for short coils, such as those encountered in radio-telegraphic work. The following formula, due to Brooks and Turner, (*see University of Illinois Bulletin, Vol. IX, No. 10*) will be found useful. This is applicable to coils whose length is but twice the diameter. The value of L is in henries.

$$L = \frac{4\pi^2 \times a^2 \times N^2}{b + c + v} XY \times \frac{1}{10^9};$$

$$X = \frac{5b + 6c + r}{5b + 5c + (.7r)};$$

$$\text{and } Y = \tfrac{1}{2} \log_{10}\left[100 + \frac{14 \times r}{2b + 3c}\right].$$

Where a=mean radius of windings. r=major radius of coil. b=axial length of coil. C=thickness of the winding; all dimensions in centimeters. N is the total number of turns in the windings.

ELECTRIC PROBLEMS.

(534.) B. Goldberg, Brooklyn, N.Y., wishes to know the correct answers to two problems which he has submitted:

Q. 1. Two parallel metal plates each 1 cm. in diameter are placed in pure distilled water, 10 cm. apart, and an electromotive force of 100 volts is connected to the plates. What is the force in dynes with which the plates attract each other, the inductivity of the water being equal to 90.

A. 1. The two plates attract each other with a force of 32×10^{-4} dynes.

Q. 2. The spiral spring of a Siemens electrodynamometer is twisted through an angle of 225° to balance the force acting on the movable coil when a current of 14 amperes flows through the instrument. A twist of 160° is required to balance the force action of current which is being measured by the instrument. What is the required value of current.

A. 2. The answer to your second problem is 11.8 amperes which is the amount of current required to turn the electrodynamometer to an angle of 160°.

COST OF RUNNING COIL.

(535.) Q. 1. Myrl Priest, Minnesota, asks:

How much will it cost to run a one-inch coil from an electrolytic interrupter for one hour at the rate of eighteen cents per kilowatt hour.

A. 1. It will cost you about five cents an hour to run the one inch coil with an electrolytic interrupter.

ROTARY RECTIFIER.

(536.) Spyker G. Kurtz, Pennsylvania, wants a diagram showing the construction of a rotary rectifier for high voltage currents.

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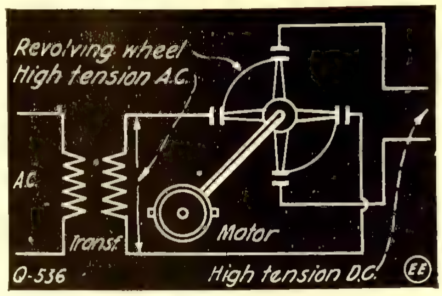


High Voltage Rectifier for Converting A.C. to D.C.

A. 1. The illustration gives a schematic diagram of such a rectifier.

Q. 2. Please give the length and diameter of both primary and secondary cylinders of the Navy Type receiving transformers.

A. 2. The dimensions of the primary and secondary cylinders of the Navy Type receiving transformers are: primary 5x4½ inches, secondary 5x4 inches.

PASTE FOR STORAGE BATTERY PLATES.

(537.) J. Bottlewood, Englewood, N.J., desires to know:

Q. 1. How is the ampere-hour capacity of a storage battery determined?

A. 1. The ampere hour capacity of a storage battery is determined by multiplying the number of amperes consumed by the instrument which uses the power of the storage battery, and the number of hours that the power is used without recharging. Thus, if a storage battery is rated at 60 ampere-hours, that means that 8 amperes of current can be drawn for 7½ hours or 20 amperes for 3 hours, etc.

Q. 2. What is the paste composed of in the positive and negative plates?

A. 2. The positive plate is coated with a paste composed of lead oxide (red lead) and sulphuric acid which is used to soften the lead oxide. The negative plate is also made of lead oxide (litharge) mixed with sulphuric acid. The pastes of both plates are forced into the pockets under high pressure. During formation of the plates the negative paste becomes converted to spongy lead, while the positive plate is converted into lead peroxide.

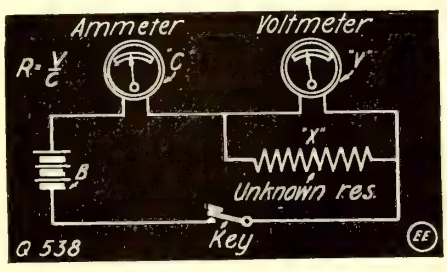
Q. 3. Are "Crowfoot" gravity batteries suitable for charging storage batteries?

A. 3. "Crowfoot" gravity batteries are suitable for charging storage batteries providing a sufficient number of them are used, as the current produced is small.

MEASURING RESISTANCE.

(538.) S. Sisselman, Atlanta, Ga., desires to know:

Q. 1. What is *Resistance Measurement* and how many methods are there whereby unknown resistances can be measured?



Measuring Resistance by Drop of Potential Method

A. 1. Resistance is that which offers opposition to the flow of electricity. Ohm's law shows that the current strength falls off in proportion to the increase in resistance. This gives a basis for measuring resistance. There are various methods by which unknown resistance may be measured as by the:

(1) Direct Deflection method,
(2) Method of substitution,
(3) Fall of potential method,
(4) Differential galvanometer method,
(5) Drop method,
(6) Voltmeter method,
(7) Wheatstone bridge.

Q. 2. Give a diagram for measuring the resistance of a coil by using the fall of potential method?

A. 2. The diagram herewith shows the connections of the instruments used. The resistance of the voltmeter should be very high, if accurate results are to be obtained.

Q. 3. What is a *ballistic galvanometer?*

A. 3. A ballistic galvanometer is an ordinary type galvanometer, but it is designed to measure the strength of momentary currents, such for instance as the discharge of a condenser. In construction, the magnetic system is given considerable weight, and arranged to give the least possible damping.

FLICKERING OF LIGHTS.

(539.) William H. Mansfield, Jr., wants to know:

Q. 1. What instrument can be used for preventing the lights from flickering when a transformer is in operation?

A. 1. The only device that you can use successfully to reduce the flickering of the lights is a choke coil.

Q. 2. What is the wave length of an aerial 144 feet long, 60 feet high with a 50 foot lead-in?

A. 2. The natural wave length of your antenna is about 400 meters.

EDDY CURRENT LOSSES.

(540.) J. Johnston, Brooklyn, N.Y., asks;

Q. 1. Explain what the copper losses are in building transformers.

A. 1. The copper losses are the sum of the I^2R losses of both the primary and secondary windings and the eddy current loss in the conductors.

Q. 2. Is the eddy current loss in the conductors large?

A. 2. The eddy current loss in the conductors is very small and may be disregarded, so that the sum of the I^2R losses of primary and secondary can be taken as the total copper loss for all practical purposes.

Q. 3. What is the special objection to oil in transformer construction and what kind of oil is utilized in transformers used commercially.

A. 3. The main objection to oil for transformer use is the danger of fire. Transformers that use oil, employ a mineral oil as it is less liable to catch fire.

GUN POWDER.

(541.) Troy Huffington, Texas, wants to know:

Q. 1. The chemicals and quantities used in making gun powder.

A. 1. Gunpowder is made by carefully mixing 75 parts of potassium chlorate ($K\,Cl\,O_3$), 15 parts of charcoal and 10 parts of sulphur. The materials used should be pulverized.

Q. 2. What is the wave length of my aerial which is 112 feet long and composed of two wires 50 feet high?

A. 2. The wave length of your antenna is 300 meters.

ELECTROLYTIC PROBLEM.

(542.) E. H. Noble, Del., wishes to find

out how many watts of electricity will be required to decompose 1 cubic inch of water in five minutes.

A. 1. The number of watts of electricity that will be required to decompose 1 cubic inch of water in five minutes would be 11.9 watts.

OSCILLATION HARMONICS.

(543.) F. M. Gaston, Memphis, Tenn. asks several questions regarding harmonics of radio waves, and the manner of tuning in such wave length multiples and submultiples?

A. 1. The upper harmonics of a fundamental wave are shown graphically at Fig. 1. At A is observed the first upper harmonic of a fundamental wave having a frequency N; the frequency of the first harmonic is equivalent to 2xN. The frequency of the second harmonic (B, Fig. 1) is 3xN, and of the third harmonic (C, Fig. 1) 4xN. Radio stations are often heard on an upper harmonic For instance, a station transmitting on a 2,500 meter fundamental wave can usually be heard on the first upper harmonic or on a wave

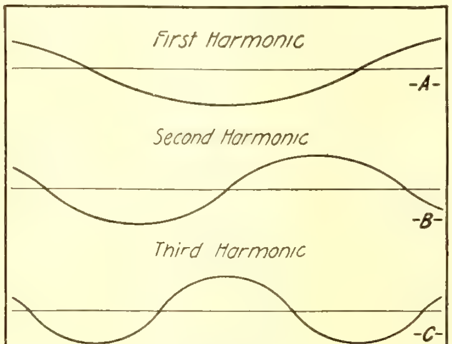


Fig. 1

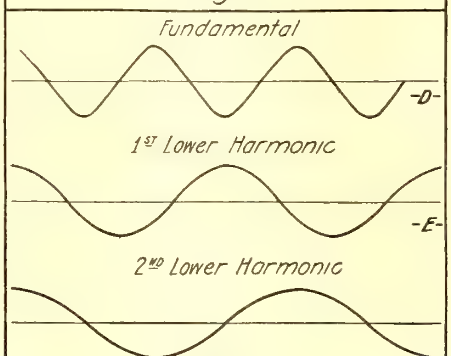


Fig. 2

Relation of Various Harmonics and Fundamental Waves

length of half this value. Sometimes the second or third harmonic may be so prominent as to enable a station tuning in at still lower wave lengths corresponding to these upper harmonic frequencies. It has been found in practise that the fundamental wave length is the strongest, however, all things considered. At Fig. 2, is illustrated graphically the appearance of the fundamental (D), first lower harmonic (E) and second lower harmonic (F). Considering the fundamental wave (D) frequency as N, then the first lower harmonic will have a frequency of ½xN; the second lower harmonic has a frequency of ⅓xN, etc. The wave length will change in proportion, i.e., the 2,500 meter wave aforementioned would be heard on the first (lower) harmonic, tuned in to 5,000 meters, this wave length corresponding to a frequency of ½xN, N being the fundamental. The third lower harmonic would have a frequency of ¼xN, and a wave length value of four times the fundamental.

Free Excursion to New York

A REMARKABLE OFFER

WHETHER you live in Portland, Maine, or in Portland, Oregon, you now have the finest chance of a lifetime to come to the famous Metropolis for your summer's vacation, *without cost to you.*

The Publishers of the ELECTRICAL EXPERIMENTER will pay your railroad fare to New York and back to your home. Hotel accommodation will be provided at a well-known New York Broadway hotel for two weeks. You may come any time between July 1st and September 30th. Just think what a chance! You always wanted to come to New York, the city of wonders, the largest and most marvelous city in the world. Will you come?

READ OUR OFFER

All we ask is that you visit your friends and acquaintances and obtain their subscriptions at $1.00 a year. Almost everybody you can think of wants to read such a bright up-to-date publication as the ELECTRICAL EXPERIMENTER. Nearly everyone has money to spare and, with a little urging, your friends and even strangers may be persuaded to subscribe. Once you get the knack you can take from eight to fifteen subscriptions a day. (Upon request, we will furnish you free with a short treatise on how to get subscriptions.) By soliciting from one to two hours a day, during your spare time, you will surprise yourself how many people you will be able to convince that they should read the ELECTRICAL EXPERIMENTER.

After securing the money send us the cash or Money Order and be sure that the envelope and letter are plainly marked "*Subscription Contest.*" You will be credited with every subscription you send in. A one year's subscription counts for one point, a two years' subscription for two points, and so on. You may subscribe for three or five years yourself by sending in three or five dollars. In that case you will be credited with three or five subscriptions as the case may be.

The individual sending in the largest number of subscriptions between now and closing date will be entitled to the free excursion to New York as described above, or one of the other prizes we mention below.

RULES

1st. All subscriptions must be sent to us within twenty-four hours after receipt of money.
2nd. The full subscription price—$1.00 in United States, $1.50 in Canada and foreign countries—must be remitted.
3rd. To win the first prize (Excursion to New York) not less than fifty subscriptions must have been sent in.
4th. Anyone, either sex, if over 12 years old, may participate in the contest.
5th. Contest closes at 12 o'clock noon, June 30th, 1916, at which time the last subscription must be in our hands. The winner will be notified at once.
6th. Winners will be announced in our August issue.
7th. Subscription agencies are not eligible to compete.
8th. If two or more persons are tied for any prize each will receive the prize tied for.

ADDITIONAL PRIZES

2nd Prize. A $50.00 Wireless Outfit (Sending and Receiving).
3rd " A $20.00 twenty-year guarantee, 17-jewel gold watch.
4th Prize. A $12.00 "Ingento" $2\frac{1}{4}$ x $3\frac{1}{4}$ folding camera.
5th " A $10.00 ten-year guarantee, 7-jewel, gold-filled watch.

IMPORTANT! **Anyone not winning a prize and sending in more than 5 subscriptions will be paid a commission of 20 cents on each new subscription he sends in. Commissions will be paid at the close of the contest.**

Someone is going to win each of the prizes. Will it be you? If you believe in yourself and in the ELECTRICAL EXPERIMENTER, you will succeed. Better start right now and convince yourself how easy it is in these prosperous times to get subscriptions for a worthy magazine. Address all letters

"SUBSCRIPTION CONTEST"

Experimenter Publishing Co. 233 Fulton Street, New York City

New 1916 Edition Wireless Manual A9

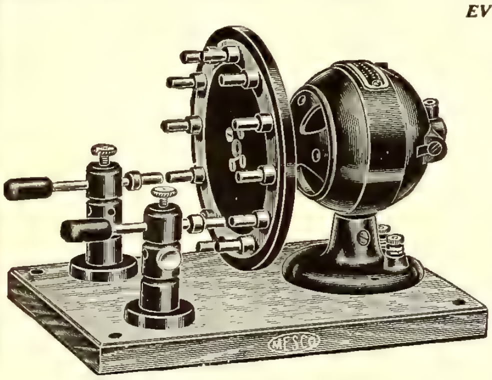
READY MAY 1st, Send 10c. for It

YOU WILL GET YOUR 10 CENTS BACK ON AN ORDER FOR $1.00

New diagrams. New matter. Everything brought up-to-the-minute. Most complete Manual as well as list of up-to-date, reliable wireless goods. We manufacture a lot ourselves and handle the very best that others make.

Our Pocket Electrical Catalogue W28, 248 pages, mailed on request. This catalogue contains practically everything in general use in the electrical line and is in fact a small pocket encyclopedia of electrical goods information.

EVERY ONE SHOULD HAVE A COPY OF BOTH



Mesco Rotary Spark Gap

Emits a high musical note. Can be heard at greater distances than the note from the stationary type. Cannot be mistaken for static or other atmospheric disturbances. Produces pure wave of low damping decrement. Increases transmitting efficiency 20 to 30 per cent.

The rotating member has twelve sparking points mounted on a hard rubber disk and is carried on the motor shaft. Can be used on our spark coils or transformers up to 1 K. W. Has two stationary electrodes with special adjusting devices.

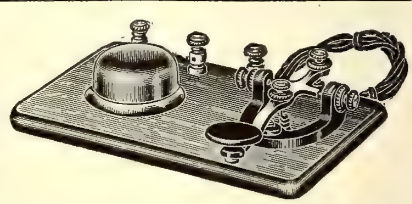
Our Globe Motor is used. Will operate on 110 A. C. or D. C. circuits; speed of 4,500 R.P.M. Also made with our Globe Battery Motor, which can be operated on a six-volt circuit.

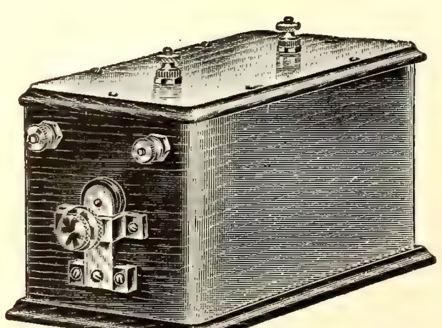
List No.		Price.
222	Mesco Rotary Spark Gap, 6 volt	$12.00
223	Mesco Rotary Spark Gap, 110 v., A. C. or D. C.	13.00
216	Rotary Unit Only, with two Stationary Electrodes for 3/16 inch shaft	5.00

Mesco Wireless Practice Set

Comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal dry battery, and four feet of green silk-covered flexible cord. The main object of the set is to enable the beginner to master the wireless code, and the buzzer reproduces the sound of the signals of the most modern wireless stations perfectly.

List No.		Price.
342	Wireless Practice Set, with battery and cord	**$1.88**





Mesco Wireless Spark Coils

Have low current consumption. Best to operate on dry batteries. Contact points of heavy platinum iridium. Has primary condenser in case. Made for wireless work. Permits of close tuning. Spark at interrupter reduced to a minimum; spark is heavy; made in ¼-inch to 4-inch sizes. Our Manual gives all the technical points.

List No.		Price.
462	Spark Coil, 1 inch; can be operated on 6 Red Seal dry batteries	**$5.40**

No advance in price of coils yet, although price of material is higher.

17 Park Place - - - New York
114 S. 5th Avenue - - Chicago
MANHATTAN ELECTRICAL SUPPLY CO.
1106 Pine Street - - St. Louis
604 Mission St., San Francisco

PATENT ADVICE

U. S. PATENT OFFICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

TIDAL MOTOR.

(68.) John Dougherty, of Cairo, Ill., submits several sketches and description of a Tidal Motor asking us to examine same carefully and advise as to its practicability and whether it will work as described. Also if there is a demand for such a Tidal Motor.

This scheme is not a new one and has been exploited before both theoretically and practically. The trouble with this scheme is that it requires a difference of thirty feet of the sea level before tide and after tide. To our knowledge this does not exist anywhere or under any condition where there would be such a large difference, it being very unusual to have even a difference of ten feet in the level of the water before and after tide. For this reason this scheme, as well as similar ones intended to fill tanks with water and to use the energy thereof after the tide has gone out, have never been proved very satisfactory. We do not say that in the future such a scheme may not be evolved whereby to utilize a small amount of difference in the tide levels, but so far nothing has appeared that is of a practical nature.

AUTOMATIC TELEGRAPH TRANSMITTER.

(69.) Leo Shapiro and Sidney Klein, of Chicago, Ill., state that they are the inventors of an automatic telegraph transmitter which is capable of transmitting telegraph or wireless telegraph messages in either the Continental, Morse or Navy code. Transmitting is claimed to be affected at any rate of speed or from five to twenty words a minute. The machine is supposed to be operated by any one, by simply pressing down various keys. The inventors ask for our advice as to the patentability, etc., of this invention.

There are a great many automatic transmitters on the market now and any textbook on electricity will show what has been done. Without having seen drawings or models of the actual apparatus, it is impossible to say what can or cannot be expected from such a machine. As a rule, however, we would say that such machines are rather expensive and there is not much demand for them on account of this. If there could be evolved a machine that could sell at between $5.00 and $10.00, we think there would be a very good market for same.

COPYRIGHTING INVENTIONS.

(70.) E. Lennert, New York City, writ· us as follows:

"Could not you, through your valuable journal, encourage a movement to have inventions registered at the same fee as a copyright, in order to give the inventor time to secure capital for a patent. I had the same idea for a telephone as that shown on page 684, of the April number of *The Electrical Experimenter.* If this registration law had been in use I could have proved priority and could have secured capital to apply for a patent. I believe the majority of inventors hesitate to invest money for a patent before they have expert advice. Will you kindly advise me as to this?"

This letter, one of many, is a strange delusion which many inventors are subject to. Up to a few years ago, the United States Patent Office accepted a Caveat which simply was a registration on a patent before the idea was entirely developed. It was thought that a Caveat would protect the inventor and would assure him a priority claim for his idea. However, very few persons made use of the Caveats and for this reason Congress abolished them and the Patent Office now refuses to accept applications for Caveats and inventors must therefore file a regular application for patent. This was a wise movement for the reason that it has been found that Caveats were not necessary, as the following will explain:—

Suppose you make a certain invention, or suppose you have an idea that you think is absolutely new; you have not, however, the money at the present time to make certain researches in order to complete the work, making models, etc. The simplest thing in this case is to write the invention down as carefully as possible embodying on the same sheet all illustrations so that anyone reading the matter will understand what the invention consists of. Take this sheet to a Notary Public whom you can trust, and have him affix the date and seal upon the sheet; or, if you do not wish to do this, ask several friends to sign their names on the sheet, being sure that the date appears thereon. Once you have this evidence it is practically as good as if you had a patent applied for. If somebody else applies for a patent afterwards and you can show to the satisfaction of the Patent Office that the date of your invention is prior to the one which might have been patented afterwards, the latter patent will be declared void for the reason that you could prove that you were first on the ground.

In any patent issue the most important point is always centered around the fact:

Who made the invention first? You must prove to the Courts that you were first on the ground when you will be entitled to all due patent protections. For this reason, every inventor who thinks he has a valuable idea should put it on paper immediately and he should assure himself that the correct date and names of witnesses appear on the same sheet.

SPARK LENGTH.

(71.) L. H.S. seeks advice on the following:

He has an idea that by putting a spark coil inside of a closed vessel and exerting a large pressure, as for instance eight atmospheres inside of the chamber that the sparking at the vibrator contacts would be eliminated. In turn the secondary spark length would be increased.

We do not quite agree with our correspondent on this point as we are quite sure that a spark length would be decreased instead of increased, for the simple reason that the vibrator in the compressed air would not swing as rapidly as in the normal atmosphere. As a matter of fact, it has been proved that by putting the sparking contacts in a vacuum enormously larger sparks can be obtained from the secondary, for the reason that the vibrator will swing faster as it is not damped by the air any longer. However, schemes of this kind are not eminently feasible for everyday use as they are too costly for the small benefit which they give.

EXPANDING MIXTURES.

(72.) Sterling Waggoner, Putney, So. Dak., claims to have devised a mixture which expands slowly, but powerfully, when a small amount of battery current is passed through it. He would like to know if such an invention is of any use; what its uses are and if it is patentable. He furthermore gives us a description of the invention explaining how it acts.

Without knowing the entire details we are at a loss to know whether the invention is new or not. There are many bodies which, when a current is passed through, will expand; for instance a solution of common salt water, when current is passed through it, will generate gas which will expand in direct proportion to the amount of current used. Of course, this is not expanding the water, itself, but it does it indirectly. Metals will also expand directly when a current is put through which heats up the metal. Offhand, we do not know of any use for an expanding mixture of the kind described by our correspondent, as it depends entirely how it can be used, whether it is liquid, semi-liquid, or solid in form. We would advise our correspondent to get in touch with a patent attorney.

PERISCOPE.

(73.) Clyde B. Marx, Kaskela, Oregon, submits two inventions; one, a spring-barb fish hook, the other a four-sided periscope. He desires to have our opinion on the two inventions.

In the fish hooks shown, we see nothing new and are quite sure that hooks of this kind are now in use. We see no improvement over others on the market now.

On the four-sided periscope which our correspondent has devised in order to see in four directions at the same time, very similar devices as this are in use by most of the Navies now. Most of the new periscopes make it possible to see all around the horizon; in other words, they cover 180 degrees at one glance.

Seventy per cent. of the people use electricity in some form every day.

Ten per cent. of the population derive their living, directly or indirectly, from the electrical industry; $7,999,862,157 invested in electrical industry, including telephone and telegraph.

Book Review

EXPERIMENTAL PHYSICS. By Harold A. Wilson, M.A., D.Sc., F.R.S. 406 pages; 75 illustrations; 6x8½ inches. Cloth bound. Price, $2.50. Cambridge University Press. Supplied by G. P. Putnam's Sons, New York.

A treatise intended for use by students of the subject and also of particular worth to the general reader. The topics treated include: Laws of Motion and Matter, Mechanics of Rigid Bodies, Properties of Liquids and Gases, Convection and Conduction, Heat a Form of Energy, Wave Motion, Musical Notes, Interference of Sound Waves, Vibration of Air in Open and Closed Pipes, Lenses, Optical Instruments, The Velocity of Light, Interference and Diffraction, Energy of Light, Invisible Radiations, et cetera.

The method of explanation involved is very commendable and brings out the salient points of many physical problems heretofore but vaguely expatiated upon by most text book writers. The chapters on light and sound are particularly well prepared. The action of wind or air in organ and other pipes provided with "stops," etc., are covered in a simple, yet thoro and scientific manner, without the use of higher mathematics. The section on sound and the component elements making up stringed instruments is of extreme interest to all students of physics. The exact reason why any piano can never produce absolutely pure music, owing to the odd divisions of the scale employed, is elucidated clearly, and conversely the reason why the violin is capable of yielding the purest music, a fact long known among expert musicians, but practically never treated upon in such works as this Simple methods of determining and measuring sound vibration frequency are offered as well as schemes for causing tuning forks to vibrate continuously. Professor Wilson has succeeded in writing a book on pure science which does not tire the reader with unnecessary facts of little or no practical value. Some of the chapters might have been elaborated upon to a greater extent it seems, but the topics embraced and their treatment more than compensate for those subjects not included.

ELECTRIC LIGHT FITTING. By S. C. Batstone, A.M.I.E.E. 317 pages, 238 illustrations; 7½x5 inches. Cloth bound. Price, $1.50. 1914 (new edition), Macmillan Co., New York.

This book is very helpful for those interested in the installation of wiring for lights, heaters, stoves and other electric appliances in the home. Although written by an Englishman on English standard fittings, the instructions are quite applicable to American work. The book contains valuable information on the use of conductors, casings, conduits and cleats. It gives a complete explanation of the methods used in installing switches, cutouts, distribution boards and lighting fixtures. The chapter on house wiring, augmented by diagrams showing the best location for fixtures, is interesting to electricians and prospective home builders. In connection with this chapter is one on direct and indirect lighting. The latter part of the book explains the installation of private electric plants. Since Mr. Batstone is an authority on the methods of electric wiring, his book should prove helpful to those interested in the subject.

EXPERIMENTAL WIRELESS STATIONS, 1916 EDITION. By Philip Edelman. 269 pages; 100 illustrations; 5½x8 inches. Cloth bound. Price, $1.50. Published by the Author, Minneapolis, Minn.

Any amateur wireless operator who wishes to learn more about the principles upon which his set works, will do well to read this book. While Mr. Edelman does not touch upon the newly developed instruments, except in the supplement, he gives clear instructions for making simple and efficient radio apparatus. Those who have read the current publications will not learn much from this book. However, it is to be highly recommended to those who are only beginning to feel an interest in radio work. The illustrations could be clearer for they are rather small line cuts and the quality of paper used does not help to bring them out very clearly.

In the supplement some of the latest discoveries are disposed of in a single paragraph. A full explanation of the weather reports, with the Beaufort scale of wind velocity is given. For those interested in patenting wireless apparatus, the patents covering this field are listed complete. This book, now in its third edition, has been well received by amateurs who want a non-technical book on the operation and construction of radio apparatus.

INVENTIONS AND PATENTS. By Philip E. Edelman. 288 pages; 5½x8 inches. Cloth bound. Price, $1.50. Published by D. Van Nostrand Co., New York City, N.Y.

Previous books by this writer have found a ready demand among experimenters and in the present volume he turns to the protection of ideas or inventions the experimenter may make and has covered the subject in a very clear manner that will be of great service to budding patentees.

The matter is not fogged with rulings and laws but endeavors to explain the requirements of a strong and valid patent. The many suggestions given in this volume will enable the inventor to get a clear grasp on the main points of his invention and he will thus be in a position to present claims that give full protection from infringement. Patent Office routine and other features are incorporated in the work.

The development of the patent system, the Patent Office, attorneys, field of invention, patent preparation, application, protection, rights, disposition and infringement are some of the subjects covered. Points on foreign patents and the present status of inventions are also dealt with. A novel idea in the makeup of the book is a number of memoranda pages for the convenience of the reader of the treatise. The appendix quotes many decisions from patent suits which will enable anyone to form an opinion on pending suits in which they may be interested. On the whole the book is worthy of a place in the inventor's library.

INJURIOUS EFFECTS OF ELECTRIC SPARK UPON THE EYE.

Although the ultra-violet rays have not any practical application to radio as yet, they have been found quite injurious to the operator who is constantly viewing the spark gap. If these rays constantly act upon the eye, they produce a troublesome irritation known as conjunctivitis.

The conjunctiva is the mucous membrane that lines the inner surface of the eyelids and covers the front of the eyeball, thus connecting the lids and the eye itself. In conjunctivitis the conjunctiva is inflamed and eyelid becomes swollen, red, partially shut and usually quite painful.

A cinder in the eye or a bruise may cause this. It may be interesting to note that the phrase "something in the eye" is not quite correct. Foreign substances do not lodge in the eyeball, as usually thought, but in the conjunctiva membrane lining the eyelid lid.

But to return to the subject. Ultra-violet rays and the sharp violet tone of a spark gap irritate, the conjunctiva and sometimes cause it to become inflamed.

To prevent this trouble wear smoked glasses when working around the spark and use the eyes as little as possible; also bathe them with an eye wash, such as a dilute solution of boracic acid. Conjunctivitis, though not usually acute, may become quite chronic unless cared for properly. The best method of overcoming the injurious effect occasioned by the spark gap is to place this instrument in a case containing a small opening covered with cobalt glass; this is used for observing the working conditions of the gap and at the same time it will prevent the harmful ultra-violet rays developed from striking the eye and thus the dangerous effects which have been mentioned, will be eliminated.

WIRELESS SUIT DISMISSED.

The wireless patent infringement suit brought by Samuel M. Kintner and Halsey M. Barnett, receivers of the National Electric Signal Co., against the Atlantic Communication Co., which operated the Sayville wireless station, was dismissed on Jan. 7 by Judge Mayer in New York. It was complained that the defendant had infringed two claims of a patent granted in April, 1909, to Reginald A. Fessenden, and four claims of another patent which applied to the manufacture of wireless apparatus.

The musical note emitted in using the wireless was one of the points upon which it was claimed that the Fessenden patent had been violated, but Judge Mayer pointed out that he could not hold that Fessenden had been the original discoverer of its value. While he was working out his idea, De Forest was actually operating commercial stations with it, and was, moreover, working at the method in his own way.

GOVERNMENT RADIO CORRECTION NOTICE.

Capt. W. H. G. Bullard, Superintendent of the U.S. Naval Radio Service, has brought to our attention an incorrect statement made in our March issue relative to the telegraph circuits to Alaska. He states:

"That in addition to the cables operated by the Washington-Alaska Military Cable System from Seattle to various points in Alaska, and the route via Vancouver, the United States Naval Radio Service maintains a chain of shore stations in Alaska, the connecting point in the United States being at North Head, Wash., for traffic other than California points, and Eureka, Cal., for California points. The North Head and Eureka stations are connected with the telegraph service in the United States and traffic agreements entered into. The Naval Radio Service is also connected with the Washington-Alaska Military Cable System in order to fill in all gaps in their circuit due to interruptions to cable service. Whenever the service of the Military Cable System is interrupted between Sitka and Seattle, messages are sent via North Head without additional charge.

The Marconi station at Astoria referred to in the original article (page 621) is connected with Ketchikan and Juneau."

In the same issue, on page 613, there is a statement which Capt. Bullard would like us to correct as follows:

"The United States Naval Radio Service maintains fifty-three stations. The chain of shore stations covers the Atlantic, Gulf and Pacific Coasts as well as the coast of Alaska. There are also Naval Radio stations in the Philippines, Guam, American Samoa, Honolulu, Cuba and Porto Rico. A large number of the stations are open to commercial business, while the high power stations at Arlington and Darien are used for Government traffic between the Panama Canal and Government departments. Other high power stations are in course of erection. In addition to the regular stations of the Naval Radio Service mentioned before, this service has charge of the operation of the high power stations at Sayville and Tuckerton, which are operated for the owners."

AN ELECTRICAL RADIATION PYROMETER.

A new electrical radiation pyrometer is described by S. L. Brown in the *Physical Review*. The plan in this instrument is to replace the thermo-junction of the Féry radiation pyrometer with an oxide resistance element. The radiation from the hot body whose temperature is to be measured is focused, by means of a concave mirror, on a very small and thin oxide element. This element is connected in series with a constant-voltage battery and a high-resistance millivoltmeter. The current, as indicated by the deflection of the millivoltmeter, is a measure of the temperature of the body whose radiation is focused on the high-resistance oxide element. The instrument may be adapted to any temperature interval by shunting the millivoltmeter with the proper resistance. For example, a temperature change from 1600 deg. to 2100 deg. Fahr. may cause a deflection of the millivoltmeter from 50 to 125 with a particular shunt, while this same district of the millivoltmeter scale may correspond to temperatures below 1600 deg. Fahr. when a higher resistance shunt is used.

ELECTRICITY VERSUS STEAM FOR RAILROADS.

Over 2,000 miles of the railroad lines of this country are now operated by electricity. In recent tests between steam and electric traction with the same load of freight up a 2 per cent. grade, the electric locomotive had an average speed of 15 miles per hour as against 7 miles for the steam engine.

Electricity for railroads means the elimination of all smoke, ashes, and not by any means last—the incessant noise of its steam prototype.

TO THE PUBLIC

WE, the undersigned, wish to announce that, due to conditions over which we have no control, it has become necessary for us to advance our prices on certain items listed in our Catalogs.

By referring to the clipping from the *"American Machinist"* below—

396 AMERICAN MACHINIST Vol. 44, No. 9
MARCH 2, 1916

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	Feb. 25, 1916	Jan. 28, 1916	Feb. 19, 1915
No. 2 Southern foundry, Birmingham	$15.00	$15.00	$9 50
No. 2 X Northern foundry, New York	19.75	19.75	14 25
No. 2 Northern foundry, Chicago	18.50	18.50	13 00
Bessemer, Pittsburgh	20.70	21 45	14 55
Basic, Pittsburgh	18.70	18 70	13.55
No. 2 X, Philadelphia	20.00	20.00	14.25
No. 2, Valley	18.25	18.50	13.00
No. 2 Southern, Cincinnati	17.90	17.90	12 40
Basic, Eastern Pennsylvania	19.50	19 50	13.50
Gray forge, Pittsburgh	18 45	18 45	13 45

METALS

Miscellaneous Metals—The present New York quotations in cents per pound, with a comparison of practically a month and year ago, are as follows

	Feb. 25, 1916	Jan. 28, 1916	Feb. 19, 1915
Copper, electrolytic (carload lots)	27.25*	25 50	14 75
Tin	44.00	41.75	36 25
Lead	6.30	6 10	3 85
Spelter	21.65	19.50	8 75
Copper sheets, base	35.00	31 00	19.75
Copper wire (carload lots)	35.00	31.00	15 50
Brass rods, base	37.00	37.00	16 50
Brass pipe, base	41.00	42.00	17 50
Brass sheets	37.00	37 00	16 75
Solder ½ and ½ (case lots)	27.00	26 12½	24 50

an authority on the metal market,—it becomes apparent that it is absolutely impossible to continue selling certain goods at our former price. Brass and copper which enter largely into our products have increased over 100% during one year and are rising steadily, due to the extraordinary conditions occasioned by the European war. Not only the metals but nearly *every* raw material on the market has increased from 25% to 200%. It is earnestly hoped that the Public will understand and appreciate the situation. We give our assurance that just as soon as conditions become normal again, our prices will be brought to their former levels and even lower if possible.

Adams Morgan Co.	La Salle Light Co.
C. Brandes Inc.	Maguire & Shotton
Clapp Eastham Co.	Mignon Wireless Corporation
Wm. B. Duck Co.	Smith & Hemenway
Electro Importing Co.	E. T. Turney Co., Inc.

STANDARD RADIO TERMS DEFINED.
Approved by the Institute of Radio Engineers.

Under this head we will define the most important radio terms each month. Save them and by pasting each in a book (properly indexed) you will have a handy radio dictionary.

21. *Brush or Coronal Losses:* Those due to leakage convection electric currents thru a gaseous medium.

22. *Cage Conductor:* A group of parallel wires arranged as the elements of a long cylinder.
Note: Any conducting element of an antenna may be a cage conductor.

23. *Capacity, Effective, of an Antenna:* The effective capacity and effective inductance of an antenna at any oscillation frequency are the equivalent capacity and inductance values determined from the following fundamental equations:

$$\omega=\sqrt{\frac{1}{LC}} \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \qquad (1)$$

where L=the total antenna inductance,
C=the total antenna capacity,
ω=the angular velocity of the free alternating currents in the antenna.

$$d=\pi R\sqrt{\frac{C}{L}} \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \qquad (2)$$

or $$d'=\pi R'\sqrt{\frac{C}{L}} \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \qquad (2a)$$

where R'=series resistance inserted at the base of the antenna and
d'=increased decrement resulting therefrom

Solving (1) and (2a) for L and C, we have

$$L=\frac{\pi R'}{\omega d'}=\frac{R'}{6\times10^8\times d'}\cdot\lambda \qquad (\lambda \text{ in meters})$$

$$C=\frac{d'}{R'}=\frac{d'}{6\pi^2\times10^8\times R'}\cdot\lambda \qquad (\lambda \text{ in meters})$$

Having the antenna inductance and capacity, the resistance R of the antenna can be determined from equation (2). This value of R satisfies the fundamental equation:

RI^2=power absorbed by the antenna,
where I=current measured at the base of the antenna.

Note: The equation
$$I=\omega CE$$
and also $$E=\frac{\pi R'}{d'}\cdot I$$
defines an effective voltage E, which is the voltage approximately given by the equation,
Energy per spark$=CE^2$.

24. *Center of Capacity of an Antenna:* See Form Factor, Note 2.

25. *Changer, Frequency:* A device delivering alternating currents at a frequency which is some multiple of frequency of the supply current.

26. *Changer, Wave:* A transmitting device for rapidly and positively changing the wave length.

27. *Characteristic, Dynamic, of a Conductor:* (For a given frequency and between given extremes of impressed E.M.F. and resultant current thru the conductor): This is the relation given by the curve obtained when the impressed E.M.F.'s are plotted as ordinates against the resultant currents as abscissas, both E.M.F.'s and currents varying at the given frequency and between the given extremes.

28. *Characteristic, Static, of a Conductor:* This is the relation given by the curve plotted between the impressed electromotive force as ordinates and the resultant current thru the conductor as abscissas for substantially stationary conditions.

29. *Coefficient, Attenuation, Radio:* See Attenuation.

30. *Coefficient of Amplification:* See Amplification.

31. *Coefficient of Coupling, Inductive:* The ratio of the effective mutual inductance of two circuits to the square root of the product of the effective self inductances of each of these circuits.

32. *Coherer:* A device sensitive to radio frequency energy, and characterized by (1) a normally high resistance to currents at low voltages, (2) a reduction in resistance on the application of an increasing electromotive force, this reduction persisting until eliminated by the application of a restoring or disturbing mechanical force, and (3) the substantial absence of thermo-electric or rectifying action.

33. *Communication, Radio:* The transmission of signals by means of electromagnetic waves originating in a constructed circuit.

34. *Compass, Radio:* A radio receiving device for determining the direction (or the direction and its opposite) in which maximum energy is received; or
A radio transmitting device for determining the direction (or the direction and its opposite) of maximum radiation.

(*To be continued*)

THE MARVELS OF MODERN PHYSICS.

(*Continued from page 96*)

this will produce a curve or kink in the line, which travels outward, or at right angles to the direction of motion of the electron. This again is the electro-magnetic wave and as the lines of force extend in all directions, it too travels in all directions. The electron vibrating in the molecule generates such disturbances and when this motion is increased sufficiently by heating, we perceive the direct results as light. All rays, no matter whether they are the short gamma rays or the long Hertzian waves, most probably originate in this manner. The different means of producing the latter in wireless work are only methods of producing the above effects on a larger scale. Consider a simple antenna consisting of a single vertical wire as shown in Fig. 6. The spark gap separates the wire from the earth as the coatings of a condenser are separated, and when charged the wire and ground act as a condenser. The lines of force then radiate symmetrically in all directions from one plate to the other. When a spark occurs at the gap, the discharge causes a sudden oscillation of the electrons in the antenna and consequently an electro-magnetic wave. The time of this oscillation depends largely on the inductance and capacity of the system, which also determines the length of the wave. A consideration of these facts ought to throw some light on the problem of directive wireless telegraphy.

To those who have puzzled over the terms "elliptically polarized" and "circularly polarized" waves, it might be said in brief that they are produced by the electron moving in an ellipse or a circle, and if moving in a straight line plane, polarized waves are produced.

A more striking electrical phenomena, and one that is a visible reminder to many people of the marvelous forces of nature, is the *aurora*. Thanks to recent investigations of electrical discharges in gases, we are certain that the aurora is an electrical disturbance. By means of the spectroscope a number of gases have been identified as forming portions of this luminosity. The pink tint is due to the rare gas *neon*, and a yellow-greenish tinge represents *krypton*. Where the energy comes from, which is here represented, is not known. Lord Kelvin has shown mathematically that it cannot come from the sun, so it is likely due to some electro-magnetic disturbances of which we know nothing.

People are generally surprised when shown how much water power is wasted in the United States every day. If they could be shown how much electrical energy exists about us, which we have no means of harnessing, their amazement would know no bounds. Now that we have the wireless transmission of energy, the next step may be the similar transmission of power, or perhaps it will be the opening up of an entirely new field of possibilities, of which we are now totally ignorant. Whatever it may be we can rest assured that the future will surely surpass the past, and possibly all of our scientific conceptions will need remodeling. Already it has been suggested that one of the most familiar properties of matter, the property of mass, is probably due to electricity. That is, that inertia of matter is electrical inertia only. This follows in part from the fact that the mass which we give to an electron is really not a measured mass, but only a computed one which we know possesses the same inertia as such an electric charge does. Whether this would apply to the positive particle is yet an open question.

No one would say that the views of the present day are final, for something new

appears at every turn, and our older theories are changed and extended. The tendency now is towards a monistic view of natural phenomena. We have atomic views of both matter and energy and these we see in their details are drawing towards convergence. Just as the imaginative flights of Maxwell were realized later in practical achievements, so also may our present theories form the starting points for new developments in the practical world.

[*This is the Fifth paper of a series prepared especially for The Electrical Experimenter by Mr. Rusk.—Editor.*]

NEW CELL THAT RENEWS ITSELF FROM AIR.

It is reported from Austria that Dr. Just of Budapest, the chemist who invented the Wolfram lamp, has discovered an electric cell, with iron and carbon electrodes, whose electrolyte is composed of an organic substance which renews its vigor from the oxygen of the air in a short time. Electrodes, having a surface of 200 square centimeters, give a current of five to six amperes with 25-volt tension. One hundred watts was taken from one cell for four hours and the cell then had half an hour's rest, and it was found that its power was completely restored.

Walter I. Slichter, professor of electrical engineering at Columbia University, New York City, believes that if the reported discovery of an electric cell was really made the feat was remarkable, since the problem had been deemed well-nigh impossible of solution.

"This is a well-known problem," he says, "and many methods have been applied to solve it, but without success. It seems hardly credible that it could be solved in as simple a manner as the dispatch would indicate. Carbon contains energy which is not easily released by combining it with oxygen, as in all our furnaces. Unfortunately it is a passive substance at low temperature, and particularly in electrolytic cells. Iron also would give energy if combined with oxygen, but this is only a little less difficult than in the case of carbon.

"If the organic substance referred to contains an acid which will consume iron we have the simple action of all primary batteries. If these were placed in series it would be possible to obtain 25 volts, but this would not be any cheaper method of getting energy than we have at present."

RADIOPHONES FOR SPAIN.

According to information recently published in the official organ of the Seville Chamber of Commerce, a company has been organized with a view to operating wireless-telephone systems in the different cities of Spain and to connect with the Spanish vessels and Spanish colonies in Africa.

The proposal contemplates the erection of stations in this consular district at the cities of Cordoba, Seville, Cadiz, and Huelva, and 29 other stations in other parts of Spain, in the Canary Islands, at Tangier, Melilla, Ceuta, and Ibiza, in Africa. It is hoped that connection can also be made with the vessels plying along the Spanish coast and, with the trains and the system, will, if possible, be connected with the regular urban and interurban telephone land lines.

It is stated that a company has been formed at Bilbao to install the lines and stations, and that the Spanish Government has been petitioned to authorize such a system.

RADIO LEAGUE OF AMERICA NEWS.

(*Continued from page 97*)

causing interference we would immediately cut down our waves. We will not allow any member to use power enough to reach the coast under any conditions unless he either uses a short wave or else has a special license.

As to our loyalty to the United States, we hope that we are not less loyal than the most patriotic citizen in the whole land. We are planning to put our loyalty into practical use. We expect in the near future to form a volunteer signal corps and to practice field work under as near actual war conditions as possible. In the meantime we can be depended upon to discover and report any unneutral or unfriendly station which might attempt operation in this vicinity.

Hoping this may be of service to you. I beg to remain,

Very truly yours,
(Signed) FRANCIS F. MERRIAM.

We are pleased to publish also a description and photo of the "Rholphakapa" Radio Club, of East Liberty, Ohio. Mr. L. G. Lease, Dean, is in charge.

The "Rholphakapa" Radio Club was organized in December, 1915, by the students and the principal of the high school. The name is a combination of Greek letters, the meaning of which is known only

to the members. The main station is located at the high school building. It is E. I. Co. equipped, except the phones, which are Brandes'. We have a 100-foot aerial, 35 feet high, suspended from the school building to a church. An 800-meter loose coupler with loading coil, silicon detector, 1½ inch spark coil and a "pancake" helix, etc., incorporated in the outfit.

Messages are picked up at most any time, although there are no stations within several miles. One of the members has his own station with 50-foot aerial, and several are preparing to put up stations. One member was absent when the picture of our station was taken.

Seated behind the table are, beginning at the left, Messrs. Chamberlain, Price, and Harshfield. Standing are Mr. Lane and the principal, Mr. Lease at the right. Mr. Green is at the phone. The club hopes to have each of the members equipped this summer. We will be pleased to hear from other wireless operators and radio societies.

WIRELESS TO JAPAN.

The Japanese Government has notified the Marconi Wireless Telegraph Company of America that the new wireless station at Funabashi, near Tokio, is completed and will be ready for transpacific communication soon. Experimental work between Honolulu and Funabashi is now going on, and the reports indicate that the system is working in splendid fashion at both terminals, which are separated by a distance of 3,400 miles. The Funabashi station is equipped with the Marconi apparatus, but is owned and operated by the Japanese Government.

The new government station at Funabashi is a 300-kilowatt plant, the same as the plant near San Francisco. There are two stations at Honolulu, each of 300 kilowatts, one facing east and the other west, one to send and the other to receive in the relay work either way.

It was said that when the new trans-Pacific service between Hawaii and Japan is opened to commercial business, the rates will be considerably lower than at present.

RAILROAD USES RADIO.

The Great Northern Railway Company is utilizing an ingenious device in the Cascade mountains wherein wireless apparatus is employed to bridge distances of one mile or less when wires fail. Communication was re-established recently when the tracks were blocked with numerous slides.

NEW WIRELESS SPEED RECORD.

A speed of 200 words a minute, said to be a record for wireless transmission, has been accomplished by the wireless station at the Great Lakes Naval Training School, North Chicago. The speed was obtained through the use of a transmitting relay and a recently invented automatic receptor.

BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page 93*)

ing by means of invisible rays, their bodies gyrating in a wonderful manner, darting hither and thither. Now they would enact

a charming sort of aërial ballet, next they would join hands and form a living wheel to rotate at a dizzy speed all over the house. They would dance, writhe, glide and perform the most unexpected and impossible aërial stunts, to the delight of the Martians. Finally, their bodies seemed to become transparent and suddenly they vanished from view entirely, not to come back. Here we had a realistic demonstration produced by unseen rays of how a body may become invisible in the fashion of our children's fairy tales. Altogether it was a very delightful performance.

"The next act, I am sorry to say, I cannot explain at all. Although our host tried to visualize it to us, we failed entirely to understand. To this minute I don't know what it was all about, but the Martians seemed to enjoy it hugely. As far as we could make it out, the Martians have a certain sixth sense, which we lack entirely, and for that reason the act in question produced no effect upon us.

"In the center of the arena there were placed three strange contrivances, with dazzling, scintillating balls suspended from metallic chains. The house was then darkened and three strangely garbed Martians with transparent rods would touch the balls at certain points in a certain (to us) queer fashion. I had never before seen a Martian laugh, but something or other must have aroused their risibilities, for I never had witnessed such uproarious laughter in all my life. They were convulsed, they shouted and hee-heed in their peculiar high falsetto voices that did one good. Even the otherwise stern, august Martian ruler shook with merriment. Our lacking sixth sense, however, prevented us entirely from enjoying the act. We neither felt nor saw anything in particular, aside from a somewhat faint tart taste at the tip of our tongue and an occasional very slight twitching of our face muscles. That was all.

"The following act was another 'musical' production, not in sounds, but in colors. 'Color-music' is, of course, known somewhat on earth already—the underlying idea being that certain colors correspond to certain fixed musical notes; thus it is claimed that C equals red, D is yellow, F-sharp blue, B-flat steel gray, and so forth. The Martians have long known this and have elaborated greatly on the original idea. They also found out early that certain notes are apt to produce certain '*tastes*' on the tongue. Thus one note may produce a slight sweetish taste and another one a tart taste. As color-music is supposed to give the same effect as sound-music both must act alike.

"The act in question resolved itself in 'music,' not to be heard, *but to be seen and tasted.* Paradoxical as this may seem, you would be surprised to know how well we, with our untrained faculties, understood and enjoyed this strange 'music.'

"The colors which produced the effect seemed not unduly strong, on the contrary they were soft and very pleasing. They seemed to originate from nowhere in particular, but they enveloped every one in the house. The colors would melt from one into another, with seldom a sharp transition. Sometimes we would see one color right through another, then again the various colors would seem to chase one another, but at no time would we see beams or shafts of colored lights. The colors simply seemed to be all around us, they even seemed to permeate us. While we were enveloped in them, we could readily 'taste' each one distinctly, the most delightful experience being when there was a ripple of colors. This would produce a corresponding 'taste ripple' on the tongue, the taste varying from that of fresh hazelnuts to tart apricots. It is odd to relate, but most of the 'tastes' seemed to be those of fruits, only once in a while there was a steely or metallic taste, which always was prevalent when the 'music' assumed sombre 'tones.' During this performance, by some hidden electrical means, our bodies were kept a-tingling and aglow in a most remarkably delightful manner, producing a very pleasing effect of well-being, impossible to describe.

"The final act was a grand series of water plays. The arena floor was lowered and in so doing produced a gigantic tank which was filled to the top with water.

"It seems that as water is so exceedingly scarce on Mars, its inhabitants love nothing better than to gaze at the precious fluid. This is, of course, easily understood in a world which is slowly dying for lack of water.

"These water plays were almost entirely physical, but few performers taking part. By cutting off all external gravitation the water became naturally devoid of weight. Thus, if you scooped out a pail full and turned it upside down you could shake the water out, but it would not, of course, fall down, for there was no attraction below it. It would, therefore, hang freely in space like a cake of ice without falling apart.

"By means of the yellow emanation rays, of which I spoke already, the water could be pushed in any desired direction, up or down or sideways. By directing several rays in a certain manner the water would be made to rise like a water spout, but it kept its shape without dropping back to the tank. Thus wonderful water arches, rings, spirals, bridges, pyramids, etc., were created in rapid succession, to be followed by marvelous geometrical designs and all sorts of patterns. During the performance colored lights constantly played upon the water figures.

"Towards the end several clever Martians, propelled by unseen rays, built a delightful water palace about thirty feet up in the air. The palace itself was no mean structure, being about twenty feet or more in height. It was amazing how quickly these performers built the structure and how realistic it appeared, although being made of nothing but pure, though plastic water. When it was finished a myriad of colored light shafts were played upon it and a huge Tos rod began to emit the peculiar beautiful Martian strains of real sound-music. At that moment every Martian stood up and gazed intently at the water palace, which still hung freely suspended in space. Suddenly, without warning, the anti-gravitational power below was switched off and the palace became a shapeless form in a fraction of a second. With a loud splash the water—its weight now restored—dropped into the tank, sending a huge spray to all sides.

"The Martian 'show' was over. . . ."

* * * * * * * * * * * * *

It seems that the Baron's sending plant on the moon must have been full to capacity. At any rate I missed his usual good-bye. I am beginning to feel peeved that his daily reports are so short and always stop so abruptly.

SYNOPSIS

I. M. Alier, an eccentric young scientist of Yankton, Mass., who claims as his own many new as well as startling inventions, far ahead of anything as yet discovered, owns the largest radio-telephone plant in the country. One evening he hears strange noises over his phones and immediately a sepulchral voice is heard. It is Münchhausen, one of the greatest yarn and story tellers of all times. Münchhausen explains how it came about that he did not die in 1797, as popularly thought, and he furthermore gives unrefutable proof that his home is on the moon at present.

Alier wants to know why Münchhausen went to the Moon and how. The latter then explains how Prussia persecuted him and how he went over to the Allies and succeeded in capturing Berlin in a wonderful manner. However, it was not a complete success, so the Baron left Europe for America. He immediately constructs a machine which is to take him into space to the moon. Münchhausen has discovered how to neutralize Gravity by means of Electricity, and he applies this invention to his space flyer, the "*Interstellar*." The machine proves a success; it responds and is lifted with tremendous speed towards the moon.

Queer things are discovered on the way to the Moon, among others that bodies lose all their weight inside of the "*Interstellar*." Finally a landing is effected on the Moon in a desert, but great hardship is encountered on account of the Moon's rarefied atmosphere. The party then leaves for the nearest mountain range, where they discover a huge subterranean cave and a lake filled with luminous fish. Bread trees are also discovered. Münchhausen next gives a vivid description of the Earth, Sun and the firmament as viewed from the Moon; he also explains how the continents and oceans of the Earth appear from the Moon. He then tells of the ponderous meteors which continually crash down on the Moon. Finally one falls down near him and the resulting concussion hurls Münchhausen in a bottomless crater, which goes straight through the Moon. He falls clear through to the other side, but his momentum brings him back to the starting point, where he is saved by his companion. They then decide to depart for the Planet Mars, but they leave behind them an automatic Wireless Plant, the "Radiotomatic," which will relay the messages from Mars to the Moon and thence to Alier. A popular lecture on Mars is also given by Münchhausen.

Within 36 days they arrive at Mars, but when they attempt to land, three floating forts capture the "Interstellar" by means of a yellow ray which benumbs them, and guides the "Interstellar" to the Planet Ruler's revolving mansion where a landing is effected. Flitternix speculates on the probable appearance of the Martians and gives his reasons on which he bases his assumption. Immediately after landing, the Martians place soft metallic caps on the travelers' heads, and they are then conducted to the Ruler's mansion.

They are conducted to the Planet Ruler's mansion and are taught thought transference as the Martians do not talk. Afterwards they are taken to one of the "Canals" and they are shown how the Sun's energy moves its waters. Later they are given an exhibition how intelligence is sent, no letters being used on Mars.

In the afternoon the visitors are shown a close view of the stupendous Martian cities, elevated over 500 feet in the air, to escape the choking Martian desert dust which prevails near the ground. They view the immense transparent buildings and are shown many other wonders.

Later they are shown a marvelous telescopic instrument and by its means they are enabled to see not only a close view of all the planets, but of the earth as well. They see the city of New York as clearly as if they had been on top of a skyscraper looking down into the streets.

This story started in the May, 1915, issue. Back numbers will be supplied at 10c. each postpaid.

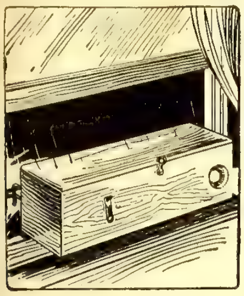
Ah! here's a good idea. Guess I'll be "short" on the Editor once and stop abruptly. Under his contract he will have to pay me the full rate for the last word anyw. . . .

(To be Continued)

20,000 LIFTS IN MANHATTAN.

In the Borough of Manhattan there are roughly 10,000 passenger elevators and about the same number used for freight. Of the passenger type one-half, or 5,000 are in buildings of 10 stories and over. About 85 per cent of all new machines are electrically driven.

NEW ELECTRIC RAIN ALARM.



The electric Rain Alarm here illustrated is placed on the window sill at night when the window is left open for ventilating purposes. It consists of a box containing a battery, a buzzer, a small electric light, and a switching arrangement that holds what the makers call a *Raino-disc.* The falling rain, which is likely at any time to drive into the room and damage furnishings, drops on this disc, switches on the current, and throws both light and buzzer into circuit. The buzzer awakens the sleeper, and the light shows which window needs attention.

The latest form of this device has the *Raino-disc* on top of the box instead of at the back. This new arrangement arouses the sleeper only when the rain is actually driving into the room, thus avoiding false alarms.

AN ELECTRICALLY TIMED BANQUET.

"We have with us to-night," was a tabooed phrase at a farewell banquet tendered Guy L. Bayley and L. F. Leurey at a San Francisco cafe by mechanical and electri al engineers of the Panama-Pacific Exposition. Toastmaster J. Fitzsimmons instead notified the speakers when to talk by electricity. Each speaker, when his turn came, "felt" the inspiration to speak. The inspiration was directed by an electric battery and spark coil. Every chair about the table was wired in an electric circuit, with the switchboard at the toastmaster's plate and the speakers arose hurriedly. The event was what might have been termed a genuine Quaker gathering, with the participants in action when the "spirit moved" them.

COPPER OXIDE ACTS LIKE SELENIUM.

Selenium has long attracted considerable attention because of the peculiar effect light exerts on its electrical conductivity. Scientists have now discovered that copper oxide has properties similar to selenium. Another mineral recently put in the same class is stibnite, an antimony mineral. Sulphur, shellac, paraffin, and anthracene, a coal-tar product, will also exhibit odd conductivity effects under the influence of light, but to a lesser degree.

The French government is encouraging experiments with a device to protect against hail; essentially a large lightning rod of pure copper, which is said to so affect atmospheric electricity that hailstones cannot form. In some parts of the country such violent hail-storms sometimes occur that much damage is done to the farmers crops and vineyards.

COST OF ELECTRICAL LIGHTS.

The following figures show how the consumer is saving through the improved efficiency of incandescent lamps. The lighting companies' revenue constantly decreases, while the cost of electric energy remains constant.

	Watts per cp.
1903 carbon lamps consumed	3.5
1905 carbon lamps consumed	3.1
1906 carbon lamps consumed	2.5
1915 100-watt Mazda lamps consumed	.95
1915 100-watt nitrogen lamps consumed	.8

These figures stand irrespective of any given rate being charged.

WIRE DATA.

In calculating wire sizes for different purposes, there are several rules which if followed will facilitate the work.

1. A circular mil is the area of a circle .001" in diameter. To find the circular mils in the cross-section of a wire, square the diameter of the wire, expressed in mils (1 mil=1 thousandth of an inch).

2. Since the resistance varies as the cross-sectional area, to double the resistance, a wire is chosen having one-half the circular mils—not one-half the diameter.

3. The Brown and Sharpe wire gauge is the standard one for electrical conductors, also brass, aluminum and copper sheet.

4. To double the resistance, or find a size of wire having one-half the circular mils area of a given conductor, add 3 sizes to the gauge of the given wire. To find the gauge of a wire having twice the circular mils area, or one-half the resistance, subtract 3 from the gauge number of the given wire

5. The ratio of the circular mils area of a wire to the area of one the next size larger is 1.26 to 1.

6. A number 10 wire is practically .1" in diameter and has a resistance of 1 ohm per 1000 feet.

LIGHT LAMPS BY WIRELESS.

Apparatus by which gas lamps can be lighted and extinguished by wireless waves has been invented in Germany it is said. The apparatus utilizes a coherer presumably.

TESLA'S EARLY WORK WITH RADIO CONTROLLED VESSELS.

(*Continued from page 89*)

any source of electrical disturbance or oscillations, the generation of which is controlled by a suitable switch at T. The handle of the switch is movable in one direction only and stops on four points t, t', u and u', so that as the handle passes from stop to stop, oscillations are produced by the source during a very short time interval. There are thus produced four etheric wave disturbances during one revolution and the receiving-circuit is affected four times: but it will be understood from the foregoing description of the controlling devices on this vessel that the rudder will be moved twice, once to right and once to left. Preferably the handle of the switch is placed so that when it is arrested on points t t' that is to the right or left of the operator—he is reminded that the vessel is being deflected to the right or left from its course, by which means the control is naturally facilitated. The normal positions of the handle are therefore at u u' when the rudder is not acted upon, and it remains on the points u u' only so long as necessary. Since, as before stated, the working of the apparatus is quite sure, the operator is enabled to perform any such operations as provision is made for, *without even seeing the vessel.*

The manner of using the apparatus and the operation of the several component parts comprising the same is in detail as follows: Normally the plate L' is turned so that brush 2 rests upon the insulated segment 23 and brush 6 upon one of the insulated short segments in the rear of the circle. Under these conditions the rudder will be turned to starboard and the circuit of the propelling motor D interrupted between brushes 5 and 6. At the same time only one of the circuits of motor F—that

controlled by relay K'—is capable of being closed, since brush 2, which connects with the other, is out of contact with the long segment 21.

Assuming now that it is desired to start the vessel and direct it to a given point, the handle T, at the transmitting station, is turned from its normal position on point u' to the point t on the switch-box. This sends out an electrical (etheric) disturbance, which, passing through the receiving-circuit on the vessel affects the sensitive device A' and starts the flow of current through the local circuit, including said device, the relay a, and the battery a'. This, as has been previously explained, turns the cylinder j and causes the brush J' to pass from an insulation space to the contact j'. The battery K" is thus closed through relay K" and the latter closes that circuit of the motor F which, starting from plate 22 (which is permanently connected with one pole of the main battery) is completed through the brush 1, the field of motor F, wire 19, the armature of relay K", wire 16, the motor m, the brushes and commutator of motor F and wire 15 to the opposite terminal of the battery D. Motor F is thus set in operation to shift the rudder to port; but the movement of plate L' which follows, brings the brush 6 back onto segment 8 and closes the circuit of the propelling-motor which starts the vessel. The motor F is permitted to run until the rudder has been turned sufficiently to steer the vessel in the desired direction, when the transmitter handle T is turned to the point u. This produces another action of the relay a and brush J' is shifted to the insulation and both relays K' and K" are inactive. The rudder remains in the position to which it has been shifted by the motor F. If it be then desired to shift it to "starboard," or in the *opposite direction* to that in which it was last moved, the handle T is simply turned to point t' and allowed to remain there until the motor F which is now operated by relay K', the circuit of which is closed by strip J' coming into contact with plate j", has done its work. The movement of handle T to the next point throws out both relays K' and K", and the next movement causes a shifting of the rudder to "port," and so on.

Suppose, however, that after the rudder has been set at any angle to its centre position, it be desired to shift it still farther in the *same direction.* In such case the handle is moved quickly over two points, so that the circuit which would move the rudder in the opposite direction is closed for too short a time interval to produce an appreciable effect and is allowed to rest on the third point until the rudder is shifted to the desired position, when the handle is moved to the next point, which again throws out both relays K' and K". It will be understood that if the handle T be held for a sufficiently long time upon either point t or t', the motor F will simply turn the plate L' in one direction or the other until the circuits of motors D and F are both broken. It is furthermore evident that one relay K' or K" will always be operative to start the motor F.

As previously explained, the longest period of operation of which the motor F is capable, under ordinary conditions of use, does not permit the motor m to shift the arm m' into contact with the plate n; but if the handle T be turned with a *certain rapidity, then a series of current impulses* will be directed through motor m; but as these tend to rotate the motor F in opposite directions they do not sensibly affect the latter, but act to rotate the motor m against the force of the coiled spring m'.

This invention will prove useful in many ways, says Tesla. Vessels or vehicles of any suitable kind may be used, as life, despatch or pilot boats or the like, or for carrying letters, packages, provisions, instruments, objects, or materials of any description for establishing communication with inaccessible regions and exploring the conditions existing in them, for killing or capturing whales or other animals of the sea, and for many other scientific, engineering or commercial purposes, but it could also be used in warfare, for by its certain and unlimited destructiveness it will tend to bring about and maintain permanent peace among nations.

On the contrary, however, this invention has not been commercially exploited, and Tesla's dreams are so far unrealized.

[Experimenters will be interested to know that the patent on this invention has run out and any improvements which they may make on the different parts of the device may be patented without fear of prosecution for infringement.—Editorial Note.]

MIMIC ATOMS AND THEIR EXPERIMENTAL FORMATION.

(Continued from page 95)

evenly at the edge of c and just on the edges of b and d, at either side of c. These two heavy cords will serve as a backing for the edges of the first few layers of magnet wire wound in c.

Fig. 2. Place the bobbin of magnet wire on the spool post of a sewing machine or on any convenient spindle. Put the kettle on a piece of newspaper, j, on a table. Allow about eighteen inches of wire for a lead and wrap this first, a turn or two, around the knot in the cord at the bottom edge of b; and then wrap the rest of the lead, g, out of the way around the handle lug of the kettle.

Begin to wind the coil, e, Fig. 3, in the space, c, by turning the kettle with the left hand while the wire, f, is guided with the right. The coil is wound with 370 turns in 16 layers of 23 turns each. At intervals of four layers it will be necessary to wrap one thickness of tape around the coil to insure an even winding. Do not let the *end turns* of a layer slip down over the edge. Whenever necessary build up an edge to wind against by melting sealing wax on both top and bottom all around the coil. The sealing wax stick, i, and the red hot poker, h, show this operation, Fig. 2. Break away the little driblets of wax that run over on the coil face. After about the first six layers it is well to bind the coil with ⅓ rd or eight of the twine ends, a; and then again after four layers with another ⅓ rd; reserving the remaining eight twine ends for binding the completed coil. *Be most careful not to break the wire at any time.*

Fig. 3. The coil is completed. Screwdriver, k, applied very carefully on both edges, chips away the wax adhering to the kettle and gently pries the coil loose from the kettle without breaking any strand of wire. With both hands, l, gently and evenly push the coil down at all points until it slips off. The coil is now securely bound with additional wrappings of twine or thread.

Fig. 4. Melt the paraffin in the bread pan, m. Have the wax at boiling point. Thoroughly wax coil, e, handling it while hot with old gloves or cloth pads. The coil will lose its shape, become flexible and droop in the hands.

Fig. 5. Put the coil while still hot over a wash basin, n, so that it will hold its proper shape while cooling.

Fig. 6 details the finishing stages; e is the coil as received from operation detailed in Fig. 5. O, first wrapping of cotton cloth and p, second wrapping; q, 6 inches of slack in the lead, g, wound noninductively around coil. Cover q with a short wrapping of cloth. In case g should at sometime break, q will be available for repair. At r is an armor of wrapping cord or marline. S, method of looping and knotting the cord; t, method of making a cord-armored lead-out; g, leads of the coil. When this is all done, immerse the coil again in paraffin, but not very long, and if necessary put over the wash basin in Fig. 5 for final cooling and shaping. When cool the coil will hold its shape and will be *waterproof.*

Figs. 7 to 15 illustrate the several stages in making and magnetizing the floating magnets.

Fig. 7. A, the magazine-pencil with pencil removed. Use flat file, b, to make brass tube end flat. Fig. 8. Use triangular file, c,

to cut several notches in filed end of a, and bevel down the brass to a cutting-edge. The result is a perfectly good home made cork-borer.

Fig. 9. The cork-borer, a, is applied to the cork, d; a must be continuously turned while pressed into d. Fig. 10. The pencil, e, pushes the cork cylinder, f, out of a. Fig. 11. The safety-razor blade, h, is used to cut cork disks, g, off of f. Each disk must be 1/8 inch thick, smooth, and well made.

Fig. 12. The sewing-needles, l, are individually magnetized by stroking them over the edges of the poles, k and j, of the magnet, i, in the manner shown. The needle is stroked from center to point over the negative pole, k, and from center to head over the positive pole, j. This will make the point of the needle a positive or north-seeking pole and the head a negative or south-seeking pole.

Cheap magnets do not come with their poles already marked. If one does not care for added nicety he may arbitrarily mark them, but it is best to determine the true polarity by magnetizing a needle; swinging it in a thread stirrup as shown in Fig. 13; noting which end of the needle swings to the north; then magnetizing another needle in the manner shown in Fig. 12. The point of the second magnetized needle should repel the north-seeking end of the swinging needle. If not, turn the magnet over, so that k and j exchange places; make another test, which will come out right; then mark the new k pole with a negative sign and the new j pole with a positive sign.

Fig. 14 shows the finished needle magnet floating on the surface of the water which is cut away in section. The point of the needle, l, has been thrust through the center of the cork disk, g, so that the needle point just barely protrudes through the upper face of the cork, the needle hanging down perfectly straight. Fifty floating magnets are made from the two packages of sewing-needles and care should be taken that they are all *magnetized uniformly and in the same direction*. They may be kept in a tin box or on a piece of "tin" or sheet iron. Handle magnets carefully and keep them apart.

Fig. 15 shows how the floating magnet is remagnetized without removing its cork disk. For best effect a floating magnet should be remagnetized every time it is used.

Fig. 16 shows all of the apparatus set up for experiment. The coil is supported by the fruit jar covers. The water just covers the coil. The floating magnets are dropped into the water inside of the coil. If the battery current is in the right direction the floating magnets will be very visibly urged away from the coil and toward its center. If this does not occur, reverse the leads to the battery. One, two or three dry cells in series will be sufficient; a greater number of cells being used for *smaller* groups and fewer cells for *larger* groups.

The resistance of the coil is about 44 ohms. Three dry cells will pass through that resistance 1/10th ampere, a very small load upon the battery. Since there are 370 turns of wire in the coil, there are 370 times 1/10th, equals 37 ampere turns of magnetomotive force acting in the coil's magnetic field.

Let the experimenter try the effects of adding more or fewer cells in the battery on different groups—of trying different numbers of floating magnets in the groups—of raising the coil partially out of the water—of tilting it at an angle—of turning it upside down to reverse its polarity, etc., and he will learn for himself the rôle played by each individual part of the apparatus, and will be occupied for days with

BE A FRIEND

to your friends. Give them this magazine when you have finished it. They will appreciate it.

a most beautiful and interesting series of experiments.

The geometric arrangements formed are not the result of any manipulation on the part of the experimenter but are the natural arrangements which the various numbers of floating magnets in a group themselves take, and *always* will take, when time enough is given them. Let the experimenter satisfy himself on this point by trying to force a different arrangement from the one preferred. However, many of the groups have second, and some even third choices in the forms which they may take. Ascertain these by careful experiment

Study the groups as they form and watch how the little magnets move unerringly into their allotted positions, propelled by unseen forces. Try to understand how all of the changing magnetic repulsive forces push this way and that against one another until finally they settle into a perfect balance or equilibrium, and the group comes to rest in the geometric configuration seen. How intricate is the interaction of these forces may be the more appreciated from the fact that the author worked several months on mathematically following up the course of a group of three magnets (or rather a general case of three repelling bodies) in seeking its triangular configuration of equilibrium.

The almost uncanny and all but intelligent way in which these little actors go about to choose their proper positions in a geometric scheme is wonderful to look upon, but more wonderful still is the significance which their arrangements have for the unravelling of the mystery of the atom. In the next paper we will learn something about this point more in detail.

(*To be continued*)

THE WIRELESS WIZ PLAYS WAR LORD.

(*Continued from page 91*)

We had the message, that is all there was to it.

The discussion was at its height, the four of us surrounded by the other members and strangely the "Wiz" seemed to be the most insistent in his questions. In the midst of the discussion all arguments ceased abruptly as a dull report reached our ears—

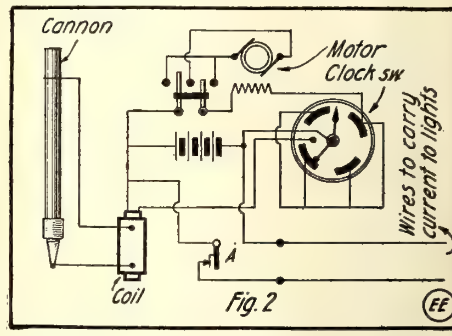


Diagram of Apparatus and Connections for Phantom Airship.

a sound not unlike the discharge of a large cannon. In our overwrought condition of mind our thoughts immediately flew to the wireless message we had copied and more than one looked scared.

Several of those gathered flew to the window and looked out into the night, only to recoil as if in horror. "Look!" one of them gasped, "there is one of the raiders now." We rushed to the windows and there, silhouetted against the dark sky, was a massive airship. It appeared to be about a mile away and was moving slowly across a gap between a tree and the next house and passed beyond the range of our vision.

It appeared not unlike the Zeppelins that are raising havoc on the British coast and a

light flashed now and then as if they were signaling.

A species of fear riveted us to the spot and with bated breath we watched for its reappearance and in about ten minutes it came slowly back, the light flashing, and then disappeared entirely.

Again the room buzzed with excited talk and we looked helplessly at the "Wiz" as if he was the only human being alive who could save the country in such a serious crisis.

"I tell you, fellows, what I'll do," he offered as if to demonstrate his power. "I can get a fast car around here in fifteen minutes, if the airship shows up again some of us will run out there and maybe be of service to the government. I'll bring along a rifle and you others get any small arms you may have access to." He went to the phone and called up a friend at a nearby garage and a few minutes later a big auto was panting before the door. Those who had weapons piled in and quick runs were made to their respective houses. Within a half hour quite a vigilant committee was gathered. The arms were distributed and all was ready for the showdown. The car with high gear in stood by the curb, rifles were loaded and a watch placed at the windows to await the raider.

It was fully half an hour before it showed itself and our half-frightened crowd of heroes rushed for the car. A crash and they were off, their goodbys drowned in the roar of the open cutout.

The "Wiz" of course was in that car, playing the leader, and they had no more than turned the corner when he ordered a halt for no airship could be seen. More mystery. But a few moments before it had been sailing serenely across the sky; now all was quiet.

"Let us go back again and find out if it dropped," he ordered. "It will only take a few seconds." So back they came, rushed into the clubroom and were reassured that it had not fallen, in fact was still in the air. They looked out of the window and behold! its large bulk was still showing against the dark sky like a dark cloud of disaster.

It is necessary to censor the remarks made the next few moments. There was the raider clear as day, yet when we went around the corner it was gone. It was bordering on the miraculous.

The "Wiz" seemed lost in thought and we looked forward to him unraveling the mystery. "I have it," he suddenly remarked. "Now watch the airship closely and you will note," he continued, as we all returned to the window, with the "Wiz" at our back, "that it is——"

Suddenly the whole yard was lit up, revealing the truth. Again, dear reader, we censor the remarks, as our eyes took in the whole arrangement of a cardboard airship strung on fine wire but a few feet from the window. We sprang around just in time to see the "Wiz" standing in the door convulsed with laughter. His ha-ha grated on our ears as he fled down the stairs three steps at a time with us in hot pursuit.

But, alas, that car was still in "high" and he got away on the jump; above the roar of its exhaust came that same triumphant laugh. To the tune of the flopping chains on the speeding car came those words—"He who laughs," etc., but why dwell on it—the memory is not sweet.

We cooled our anger somewhat by ripping out the whole device and we quieted down somewhat in respect for the simplicity of the scheme he used in fooling us.

The airship was cut from heavy cardboard and slid over two fine steel wires supported at one end by a box fastened to the side of the house and a board fastened by means of heavy springs to the limb of a nearby tree. It moved parallel to the side of the club-house and about twenty feet distant. The box contained the apparatus for operating the airship, cannon and small lights.

A cheap alarm clock controlled the operation; the dial was fitted with five insulated contacts. Four of them were arranged so the minute hand would touch them; these were brass strips that covered a range of five minutes, the fifth was touched by the hour hand and closed the circuit that ignited the charge of powder in the cannon. The latter consisted of a length of gas pipe fitted with a spark plug as used in internal combustion engines.

A trip of the ship one way consumed five minutes and knots in the wire at the proper place served to throw the reversing switch which was connected to the small motor.

A wire running over pulleys and around the shaft of the motor served to move the model to and fro.

To flash the lights on the airship a pivoted lever, with a contact mounted on the rear, was arranged to rub against the moving wire. The wire moved it off the contact and held it open till gravitation overcame the friction and the contact closed again. This device operated regardless of the direction in which the belt traveled.

An ordinary arc light connected to the lighting circuit and controlled by a switch near the door was used to illuminate the scene.

The device was realistic to an extreme, and the effect was heightened by proper staging, being especially so in our case, due to the excitement of the moment.

Still the mystery of the fake wireless message was unsolved. The "Wiz" was no fool and knowing his great respect for the law I realized that he would not send a false message and thereby break his promise to conform to the Wireless Law.

It took me two weeks to get the "Wiz" cornered and admit his method and tell the world it was easy when explained.

It seems he had thrown a fine bare copper wire over my aerial and by using a buzzer and key he sent the message into my set. This also explained why I was unable to tune the message.

By these means had he made good his boast. As our friend Shakespeare was wont to remark: "There are more things in heaven and earth, Horatio, than are dream't of in your philosophy."

WHEN NEW YORK CITY TURNS ON THE JUICE.

(*Continued from page 80*)

and cabarets. Notwithstanding that the great metropolis has the reputation for staying up all night and going to sleep in the morning, such is not the case to any great degree as may be judged by the evidence here produced. Most of the good citizens are glad to trace their steps slumberward when the hour of twelve approaches, but as some of our hybrid story writers would prefer to have it, gaiety proceeds until 3 o'clock, when the lowest dip in the load curve appears and New York is asleep at last, *but only for one hour.*

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC.

Required by the Act of Congress of Aug. 24, 1912, of THE ELECTRICAL EXPERIMENTER, published Monthly at New York, N.Y., for April 1, 1916:

State of New York, County of New York, ss. Before me, a Notary Public, in and for the State and County aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the Editor of THE ELECTRICAL EXPERIMENTER, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business managers are:

Publisher, *Experimenter Pub. Co., Inc.* *233 Fulton St., New York*
Editor, *H. Gernsback*.....*233 Fulton St., New York*
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3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are (if there are none, so state): *None.*
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5. That the average number of copies of each issue of the publication sold or distributed, through the mails or otherwise, to paid subscribers, during the six months preceding the date shown above is. (This information is required from daily publications only.)

H. GERNSBACK, *Editor.*

Sworn to and subscribed before me this 30th day of March, 1916.

[SEAL.] HENRY A. WALLENSTEIN, Notary Public, New York County, No. 15. (My commission expires March 31, 1917.)

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FOR SALE—Complete E.I. Co. Tesla outfit, including 2-in. spark coil, condensers, spark gap, Tesla coil, geissler tubes. It cost $20. E.I.Co. "Interstate" wireless reciving outfit, never used. Condenser and detector, $20. Telegraph Instructor with records and book; 15-jewel Elgin movement watch for $8; 4 volt battery motor; 50 Ohm relay. Everything new or in good condition. All letters answered. W. S. Hinegardner, Nokesville, Va.

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FOR SALE—800 meter loose coupler, electrolytic detector, 2000 ohm phones, wireless key. For particulars write. Heber Lyons, R.D. No. 2, Sacramento, Calif.

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SEPTEMBER, 1916 15 CENTS

The Electrical Experimenter

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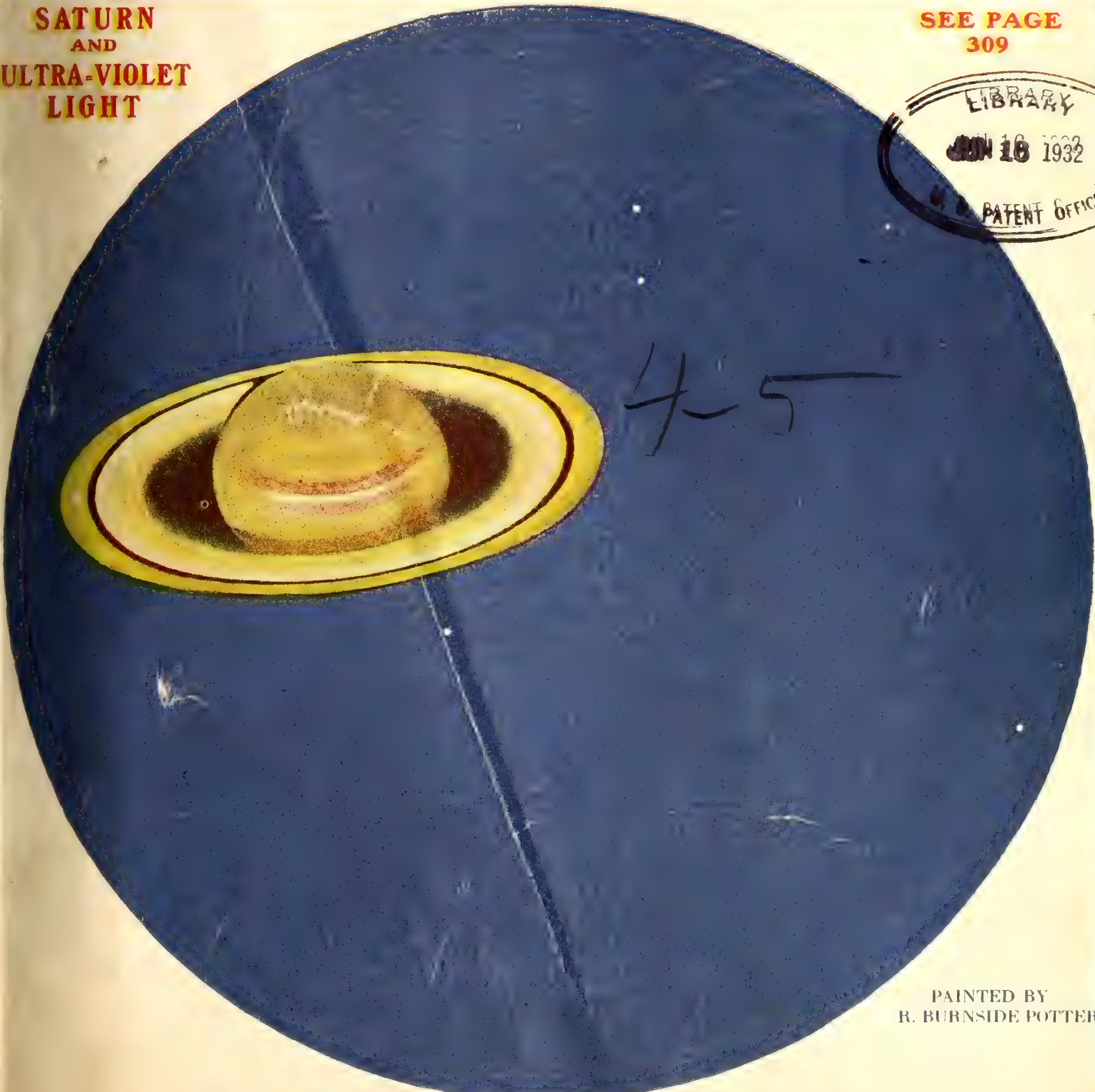
SATURN AND ULTRA-VIOLET LIGHT

SEE PAGE 309



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The Electrical Experimenter

233 Fulton Street, New York.

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Vol. IV Whole No. 41 CONTENTS FOR SEPTEMBER, 1916 No. 5

Energy Direct from the Sun

EVERY time you switch on the electric light, every time you light the gas stove, every time you board a train, every time you eat, you are paying tribute to the sun. Whether the electricity that feeds your lamp is generated by a dynamo driven from a steam engine, which in turn obtains its energy from coal, or if the dynamo is driven by a waterfall makes little difference. The energy in both cases originally came from the sun. The coal which we burn was not always coal. Thousands of years ago plants, trees and vegetables—whole forests—were being covered by water, decaying all vegetable matter, only to sink below the ground, and to be covered with sand or earth. This vegetable matter, by various processes through the ages, finally became carbonized. This is our coal. Now, of course, the trees and plants originally were brought to life by the sun, for there could be no tree without the indirect influence of the sun. Therefore, coal is stored up solar energy. The energy we derive from waterfalls also has its origin in the sun. For, if the sun did not shine there would not be any rivers. All the waters would find their way to the oceans, there to remain. In a very few months all clouds would have given up their waters and new clouds could be formed no longer, as water does not evaporate to form clouds without heat. And it is the sun that supplies the heat. Then again, whether you eat cornflakes or beefsteak, both would soon disappear from the face of the earth, should the sun cease to shine. No vegetables can grow without the sun, and in turn no animals, which to subsist must eat vegetables and drink water.

Thus it is plain that our lives are wholly dependent upon the all-dominant sun, but we are apt to forget this important fact during our busy days and pay scant attention to this great truth. We smile a superior smile at certain savages who worship the sun, but their strange religion is at least based upon a great scientific truth, let us not forget this.

Our most efficient tungsten lamp returns to us in useful light *6-10 of one per cent* of the original energy contained in the coal. In other words, we lost 99 4-10 per cent of energy in first burning the coal, then heating the water in the boiler, which in turn generated steam and so drove the engine; the dynamo coupled to the engine then produced electrical energy, and finally the latter heated the tungsten filament to incandescence.

When we soberly contemplate this ridiculous, roundabout way of obtaining energy from the sun, the shocking fact is brought home to us into what utter childhood our knowledge of things in general is still plunged. In the past years we have heard much about "electricity *direct* from coal," which means that if an economic, practical way were found to extract electrical energy from coal without the intermediary of the wasteful steam engine, an enormous amount of power would be saved. Edison and a score of well-known scientists have worked upon the problem, but practically no headway has been made. Nor is it desirable or necessary. For, if the sun produced the energy in the coal originally, why try and extract it from the coal, which is expensive and upon which more energy must be expended in mining it?

Why not extract the energy from the sun *direct?* Elsewhere in this issue is shown an invention which, in time, may have the most far-reaching consequences. Mr. Theodore W. Case's new photo electric cell produces electricity simply by letting the sun shine on the cell; it may be said that this is the ideal way of obtaining the sun's energy. While we feel very enthusiastic about Mr. Case's invention, we must caution the over-optimistic not to expect big things at once. The new cell furnishes but a very weak and as yet an almost useless current. But a beginning has been made and a way has been shown us. It will pave the road for greater things to come.

H. GERNSBACK.

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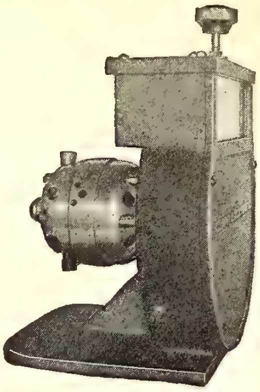

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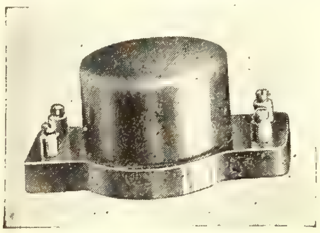

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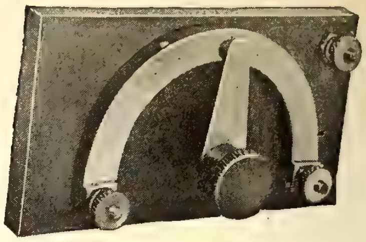

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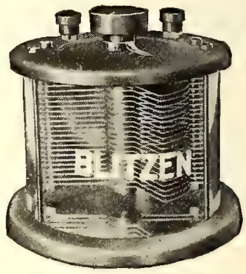

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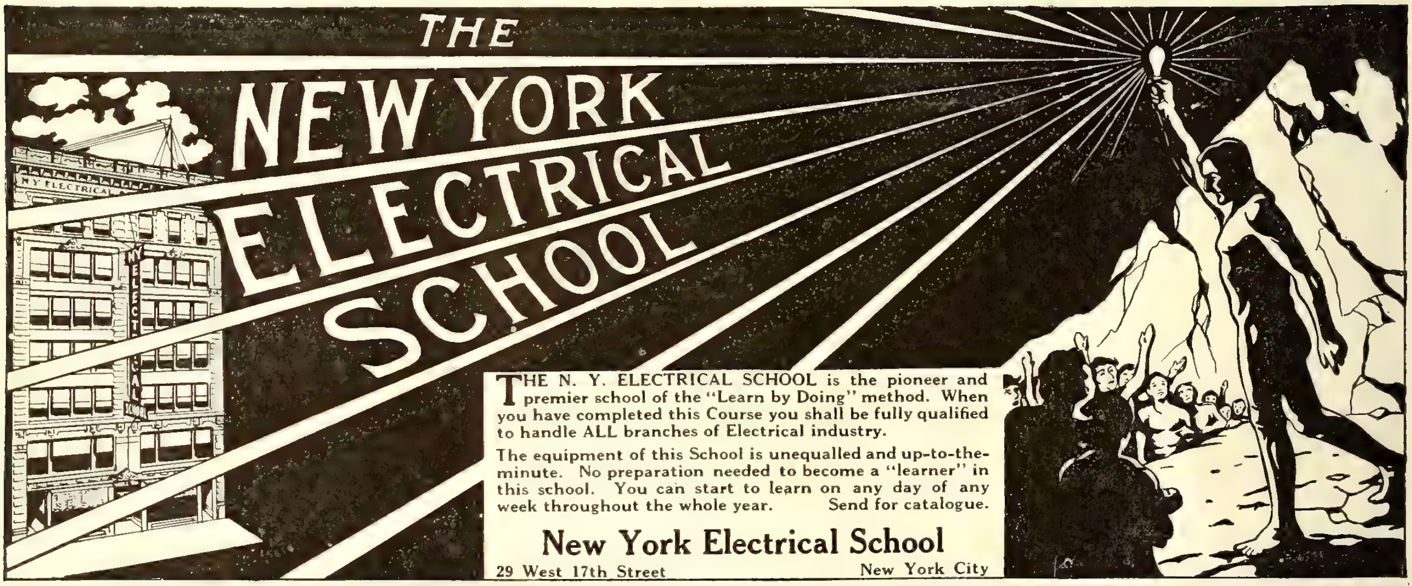

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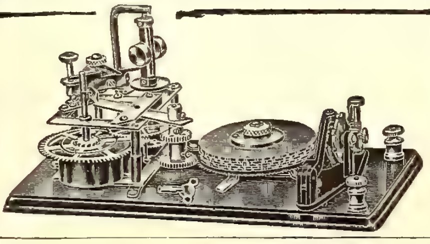

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THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
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Vol. IV. Whole No. 41 SEPTEMBER, 1916 Number 5

The Mysteries of Ultra-Violet Light

RECENT research by a small army of physicists has resulted in the presentation to this old world of a new light. As might be expected in so commercialized an age, the new light has already been put to work, while America and France, or to put it more literally, private individuals in both countries are cooperating in an endeavor to extend its industrial uses. Oddly enough, the new light is not used for illuminating purposes, except in a figurative sense, for it is invisible. To avoid becoming confused by the paradox of invisible light, it may be advisable to turn to the more familiar form of light for a starting point.

Everyone knows what light is, that is, everyone except those who have spent most of their lives trying to find out something about it. The ancients opened the proceedings by submitting proof that light was something originating in the eye which went out to the object viewed, gathered an impression and went back to the brain. One philosopher after another has settled the whole subject to his own satisfaction, only to have some later investigator prove that he knew very little about it, and often the little he thought he knew was not true. Thus, Newton showed that light consisted of exceedingly small particles of matter projected at enormous speed from luminous bodies. Huyghens, the Dutch philosopher, who lived more than two hundred years ago, maintained that light was propagated in waves in all-pervading substances which he called the "luminiferous ether." Long afterwards George Green, trying to convey an idea of the ether called it an elastic solid. Lord Kelvin, endeavoring to elucidate Green's idea, referred to the ether as a weightless jelly-like matter.

More than a century after Huyghens formulated his theory, Augustin Fresuel, a French government engineer, took it up, proved it correct and carried it further along. Still later James Clerk Maxwell, the brilliant Scottish philosopher, demonstrated conclusively that light consisted of electrical vibrat: ns. Hertz confirmed Maxwell's theory and embroidered it with interesting details.

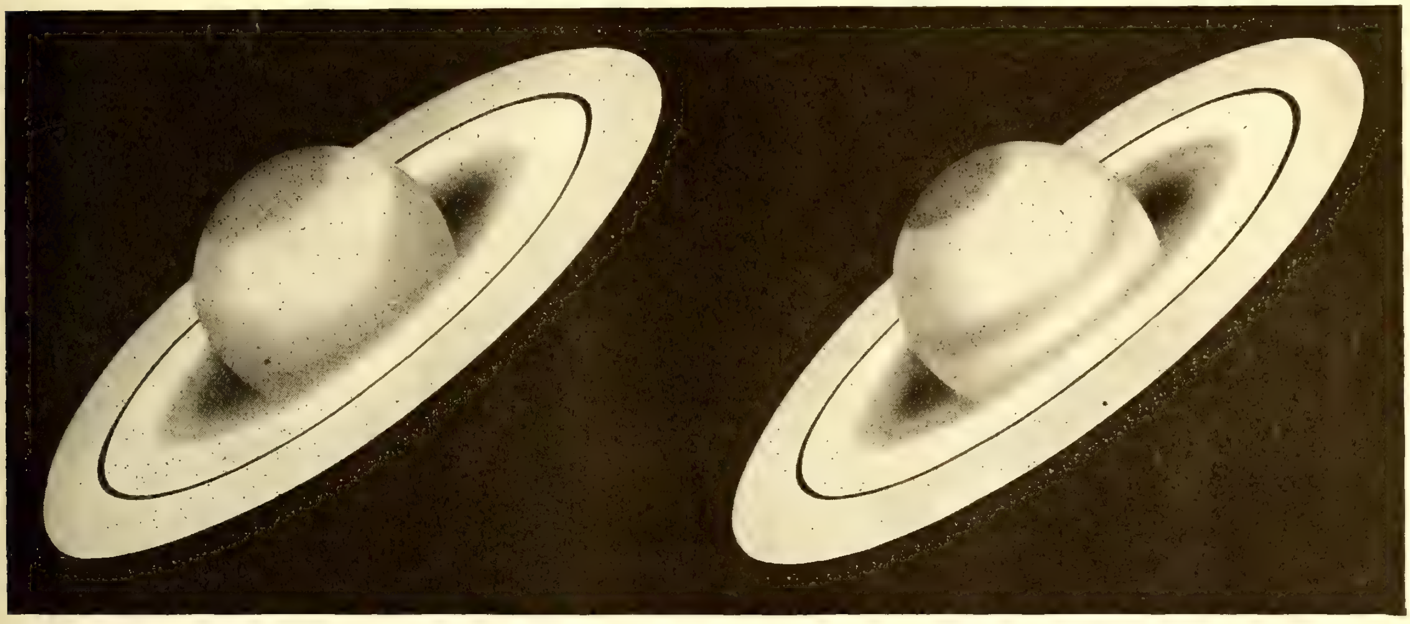
Meanwhile it is still safe to assert that light, whatever its composition, travels at the rate of 186,000 miles per second. When a wave of light is captured and dissected in a spectroscope, it is found to consist of a compound of colors ranging from red through orange, yellow, green, blue and indigo to violet. Each color travels in waves of different length, red being the longest and violet the shortest.

This rainbow-lined band, called the spectrum, embraces all of the light that is visible but includes only a part of the total. Webster would restrict the definition of "light" to that agent or force in nature by which we see. But C. P. Steinmetz, who, undoubtedly knows a great deal more about it than Webster, would have it that, "Radiation is a form of energy, the most conspicuous form of which is light." This seems to establish a basis upon which invisible radiation can claim relationship to light. In fact, the only difference between visible and invisible rays is in the length of the waves; so that if our eyes were only adapted to it, we could see by the one as well as by the other.

As it is, radiation is visible as light in a very narrow range of wave lengths, but this does not prevent the invisible radiation from being accurately studied by other means, though the eye is undoubtedly the best organ of vision yet devised.

In order to better understand what follows let us conduct the following well-known experiment:

A ray of light (coming from the sun or from an artificial light source) S is made to fall through a fine hole in the wall or door of a darkened room. This light ray will produce a small circular spot on the floor as seen at S'. We now place a glass prism, P, in the path of the light ray, as seen in the illustration, Fig. 1. We immediately observe the light spectrum, V R, which will be thrown on the white screen,



Ultra-Violet Light Plain or Yellow Light

Fig. 5. The Planet Saturn Photographed in Ultra-Violet and in Ordinary Light. Note the Broad Belt and Large Polar Cap in the Picture on the Left Side. According to Professor Wood, This Belt Indicates an Atmosphere of Chlorine Gas or Perhaps Fine Dust.

E. The prism thus has dissolved the white ray into its component colors. At the top is seen Violet, at the bottom Red. Between these two colors there are an infinite number of other colors, but the human eye only sees seven colors.

Fig. 2. A Vase of Flowers Photographed in Visible and in Invisible Light. The Contrast Is Very Marked.

Again referring to the illustration V stands for violet; I is indigo; B is blue; G is green; Y is yellow; O is orange; R is red. But beyond V and R are other colors invisible to our eyes; if we only use the proper instruments it is found that beyond the violet there is another color: the ultra-violet—a chemical light ray. Beyond the Red there is found the Infra-Red—mostly heat rays.

Ultra-violet rays are the friends of man in many ways, but they will tolerate no familiarity. To allow them to enter the eye is to invite trouble. There is no warning sense of discomfort at the time, but from six to eighteen hours after exposure, violent pains are felt in the eyes accompanied by headache. The sight is seriously impaired and it takes years to recover from the effects. Prolonged exposure to the rays may result in total blindness. Not only are these rays dangerous to the naked eye, but they are also more or less destructive to life, though in moderate amounts they have a healthful tonic effect on human beings. Sunlight, which is so stimulating to human beings, is too strong in ultra-violet light for bacteria to live in it. Sunlight is one of the best germicides known and it is by far the cheapest. No one who spends a great deal of time out-of-doors and who keeps the windows of his rooms open to allow the sunlight to get in, need worry about consumption.

Although the sun is the only natural generator of ultra-violet light, there are other means by which this light can be produced in quantity. The best apparatus devised for this is the mercury vapor lamp, especially the arc lamp when the electrodes are built of iron.

One of the most important properties of the ultra-violet light is that it will not go through ordinary glass, but it will penetrate through Quartz with ease. Professor R. W. Wood of Johns Hopkins University has employed silvered quartz for his experiments. Pure Quartz may be used as well as the vapor of bromine, which may be contained in a suitable transparent cell. Consequently pictures cannot be taken with a camera having ordinary glass lens, but must have this changed for a Quartz one.

The greatest fault with pictures taken by ultra-violet light is that details are lost, for the high and low lights are not clearly brought out. Fig. 2 shows a vase of flowers taken with both ordinary light and ultra-violet rays. Note the difference between them, the one at the right is completely killed as compared with the other. This effect is largely due to the fact that when a Quartz lens is employed for photography purposes it not only admits the ultra-violet light but all the other lights as well, making a sort of a compound image upon the plate. This great defect has been eliminated to a certain extent by employing filters for filtering out some of the colors of the unnecessary light and thereby permitting exclusively the ultra-violet light to expose the photographic plate. With the use of these filters wonderful results have been obtained.

Another very interesting property of ultra-violet light is that it will reproduce in black, marks made on paper, with Chinese white and white ink. This property is advantageously employed to expose forged checks or any document which has been changed by means of white ink. Fig. 3 depicts a photograph of a "raised" check taken by invisible rays. Note the erasure on the "Hundred" in the upper illustration. Detective agencies are constantly employing ultra-violet light for detecting such forgeries which are quite often found.

As it was stated at the beginning, ultra-violet light is an excellent germicide. Now many doctors and hospitals have installed mercury arc lamps constructed entirely of quartz for use in the production of invisible light for sterilizing purposes. A large number of these lamps are employed in the medical profession for curing different skin diseases such as ulcers, etc. The Finsen Institute of Copenhagen, Denmark, has devoted its time to curing different diseases with the aid of the ultra-violet light.

The most remarkable results, however, which are as wonderful as they were unexpected, have been obtained recently by Professor Wood.

This scientist at his summer home on Long Island investigated a number of heavenly bodies by means of these invisible rays, with astonishing results. He first photographed the moon in ultra-violet light by means of his horizontal reflecting telescope having a 56-foot focus and a 14-inch aperture.

In Dr. Wood's experiments no camera was used. The photographic plate was placed in a special frame before the lens of the giant telescope, and after it had been trained on the moon Dr. Wood moved it slowly, following the movement of the satellite until the necessary time for the exposure had elapsed. Specially prepared plates had to be used and great care was necessary during the whole photographic operation to prevent the marring of the picture by too hasty a movement of the telescope. The result is seen in Fig. 4.

Dark spots appeared on the moon's surface in ultra-violet light photographs and did not show at all in the photographs made with the visible (yellow) lights. In this respect the spots have the properties of sulphur, *and Dr. Wood has been able to conclude that there is sulphur present in the moon*, probably in rocks or other hard substances. With the agency of these wonderful rays we thus know definitely that large deposits of sulphur must exist on the surface of our satellite.

The photographs taken during the experiments are of very small size but are clear enough to bear considerable enlargement. The laboratory work which will be done with them will be performed directly from the negative, since the plates used were especially prepared for the experiments with the various lights, and the scientific value of the pictures is contained entirely in the plates and not in the prints made from them.

Professor Wood next investigated the planet Saturn. Here also a curious discov-

Fig. 6. Garden Scene Photographed in Infra-Red Light in Broad Day Light. Note the Pitch Black Sky and Black Shadows.

ery was made. It is portrayed in Fig. 5. This picture was made from an enlarged photograph as the original prints were too small to lend themselves to a satisfactory reproduction in this magazine.

The photographs were, of course, taken at night. The fact that there is no light from the sun falling upon the earth at that time makes no difference in the use of the ultra-violet rays, since, as the light from the planets is merely reflected sunlight all the rays that are present in the sunlight of the earth's day are to be found in the reflected light coming from the heavenly bodies.

The photograph taken of Saturn in ultra-violet light, shows a dark belt of considerable breadth about the middle of the planet. This belt was invisible in the yellow and all other rays, and therefore Dr. Wood first thought that it denotes a substance in the atmosphere of the planet which stops the ultra-violet rays. This substance he believed to be a fine dust. By dust Dr. Wood means a mist or fine fog and not dust in the ordinary sense of the word. While possible, this theory is hardly probable and Dr. Wood now is of the opinion that the belt might perhaps be chlorine gas which absorbs violet and ultra-violet light very strongly but is transparent to yellow light.

Before it can be definitely decided which of these two theories is the correct one more spectrum analyses will have to be carried on in conjunction with the photographs already made. At present Dr. Wood is rather undecided as to which theory is correct, but hopes that he may be able to prove the dust theory. However, he says that it is more than likely that the presence of the absorbing gas will be eventually demonstrated and that the dust theory will be disproved.

It is interesting to note that with all the photographs of the planets which he has taken Dr. Wood has not been able to get any that he could feel sure were representations of the surface of the bodies. The atmosphere about them all is of such depth and density that even the ultra-violet rays will not penetrate it clearly, and therefore the moon is the only body on which he has been able to analyze the surface to any extent.

In the pictures of Saturn in yellow light, one of which is reproduced in Fig. 5, there is a faint dark line around the body of the planet, for which no adequate explanation has as yet been given. A polar ring—the dark space at the top of the planet—is less pronounced and lighter in the yellow light, and no satisfactory reason for this phenomenon has as yet been worked out.

Fig. 4. Showing Section of Moon. The Original Plate, Taken by Ultra-Violet Light Shows a Spot Very Plainly, Not to Be Seen on the Other Plates. The Spot Is Thought to Indicate Sulphur

In taking the pictures, and especially in taking those in the infra-red rays, extremely long exposure had to be made, necessitating all night manipulation of the telescope, slowly following the course of the planet. Several assistants at the Mount Wilson Observatory aided Dr. Wood in his vigils.

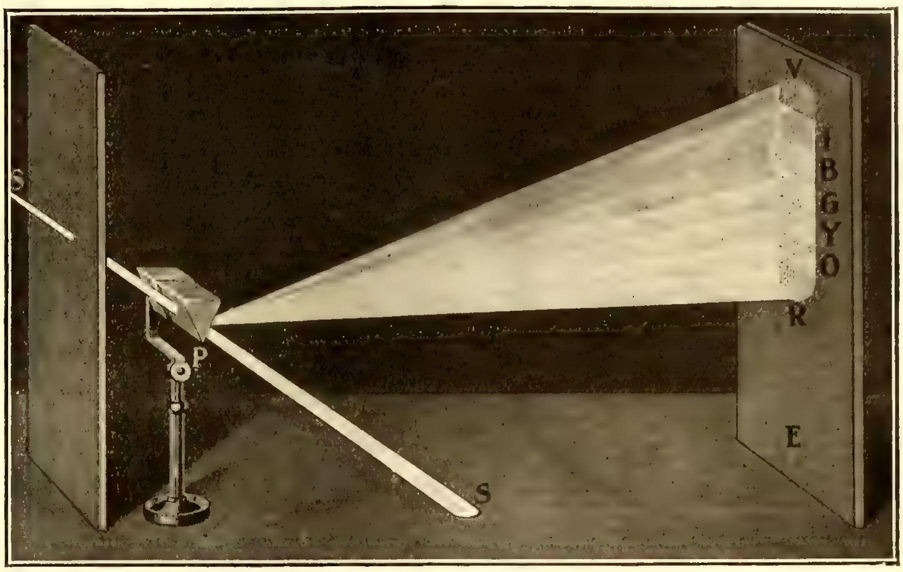


Fig. 1. How a Ray of White Light Is Dissolved in Its Component Colors by Means of a Glass Prism. The Invisible Ultra-Violet Rays Lie Beyond the Violet V, the Invisible Infra-Red Rays Are Beyond the Red R.

In the photographs of Saturn the rings which are always connected with that planet in the popular mind showed up strikingly. In the case of pictures by all lights the two rings were plainly visible, the inner one light and the outer one dark.

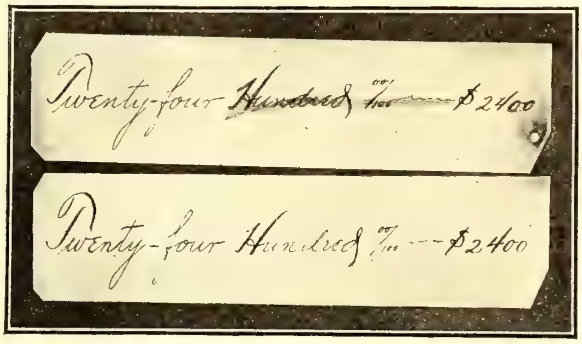


Fig. 3. Detecting Forged Checks by Means of Ultra-Violet Light The Top Picture Shows Check as Photographed in Ultra-Violet Light, the Bottom Picture in Ordinary Light.

To give the reader a good idea how the planet Saturn appears in the telescope, we reproduced it in its full colors on our front cover.

Few people realize what a strikingly beautiful object Saturn is and what a truly wondrous spectacle it presents to the eye as it floats in space, 91½ million miles distant from the earth.

Through the courtesy of Mr. R. Burnside Potter, member of the Society for Practical Astronomy, we are able to present a *true* picture of the planet Saturn. Mr. Potter, who not only is an able astronomer but a very able painter as well, graciously loaned us the painting, which is a very valuable one, and supposed to be the only one in existence.

The following is an extract from a lecture by Mr. Potter before the Society for Practical Astronomy held at Chicago, August 16, 1915:

"The painting of Saturn which is on exhibition here to-day, and which is the subject of this brief paper, was made for a special purpose, and I hope to forestall criticism by saying that it has no pretense to great scientific accuracy. It is intended to give a painter's impression of what an ordinary observer may see in an instrument of moderate size. This instrument was a sixteen-inch Newtonian reflector by Mr. Mellish. The mirrors were in perfect condition, and except for the usual slight haze on the horizon, observing conditions were as good as they ever are at my station. The view represents the planet as seen with a magnification of 580 diameters. As a matter of fact, more detail was seen with lower powers, but I used this eyepiece to make the drawing because it made the objects appear larger in proportion to the size of the field than a lower one would have done, whereas a higher power would not have permitted me to get in all the satellites. The reproduction which appears on the front cover of this magazine should be held at twenty-nine inches from the eye. This reproduction, while very successful as far as the planet itself is concerned, of course, makes the sky appear very much too light, owing to the fact that the three-color process was used. It gives a good idea, however, of how the planet looks in twilight, although I doubt if Enceladus would be visible. The colors I used, besides black and white, were rose madder, aureolin yellow and cobalt blue, and the painting was made from very careful notes and sketches at the telescope, and from a sketch in oils, half the size, worked up the next morning as soon as it was daylight.

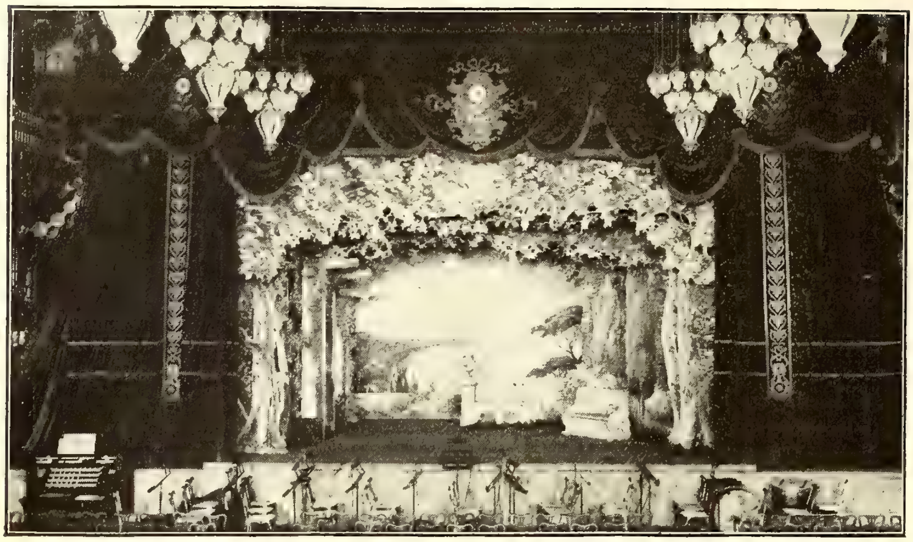
"This is the first time to my knowledge that oil color has been used to attempt exactly this sort of thing, and I do not pretend that the medium is extremely appropriate. It is a very difficult matter and requires a very steady hand to draw ellipses at this scale with a brush charged with pigment. What I wanted to show, however, was the glare which appears around all bright objects in a reflector of that size and to bring out the color of the planet and satellites, and all I can say is that my efforts in this respect were conscientious.

"The date of observation was October 21st, 1912, 2 a.m., Eastern Standard Time. The dimensions of the ball and rings were taken from Young's *General Astronomy*. The positions of the satellites were noted

(*Continued on page 362*)

Electricity, the Mystic, in Modern Hotel Service

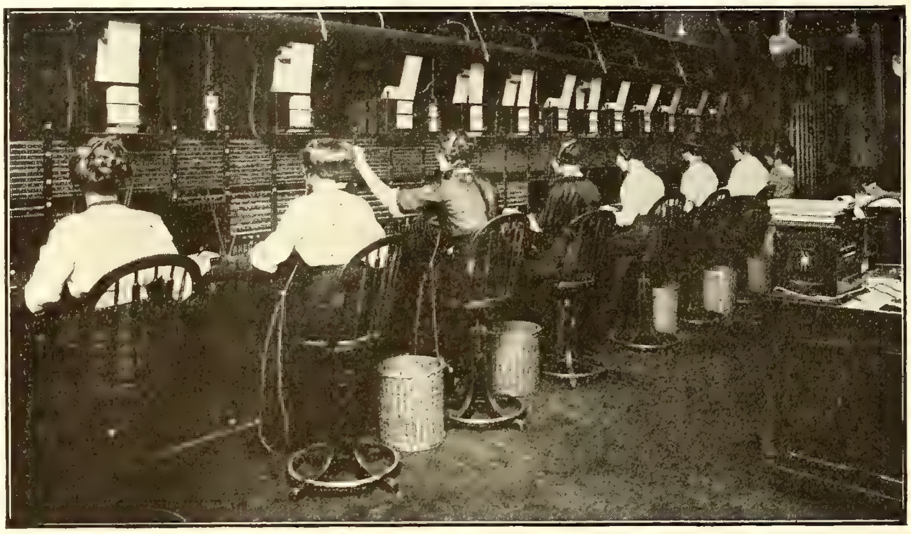
THE hotel of our grandfather's day was usually about the size of an ordinary farm house, and the conveniences and appurtenances of our best hostelries, even of one decade ago, were truly but few in number. It is a far cry from the candle-lighted reception room of the old time tavern to the modern Twentieth Century establishment with its thousand and one novelties and luxuries with which Mine Host endeavors to please his guests.



Where the Hotel Astor Entertains Banqueters; the Stage in the Grand Ball Room.

The modern battle-cry of the hotel managers nowadays is Service—first, last and always. Electricity has come to their aid in many interesting and wonderful ways, and we have endeavored to chronicle here some of the more prominent features actually in use.

To start with, most of the large hostelries in such cities as New York, Philadelphia, Chicago and San Francisco, are provided with their own electric generating plants. The plant is usually steam driven and the whole including boilers, engines and dynamos, is situated below ground. The power plant at the Hotel Astor in New York City, for instance, is rated at 1,000 kilowatts or approximately 1,350 horse-power. The electrical generating equipment comprises four 250 kilowatt, direct current generators, and the normal hotel load is carried by two of these machines, thus giving two reserve units for emergencies. This plant, like many others of similar design, is equipped with a large storage battery of 6,100 ampere-hours capacity, which is capable of carrying the entire load for several hours in case the dynamos or engines should fail, especially as no emergency connections are arranged for with the commercial electric-lighting system. Over 1,200 electric motors are used throughout this building.



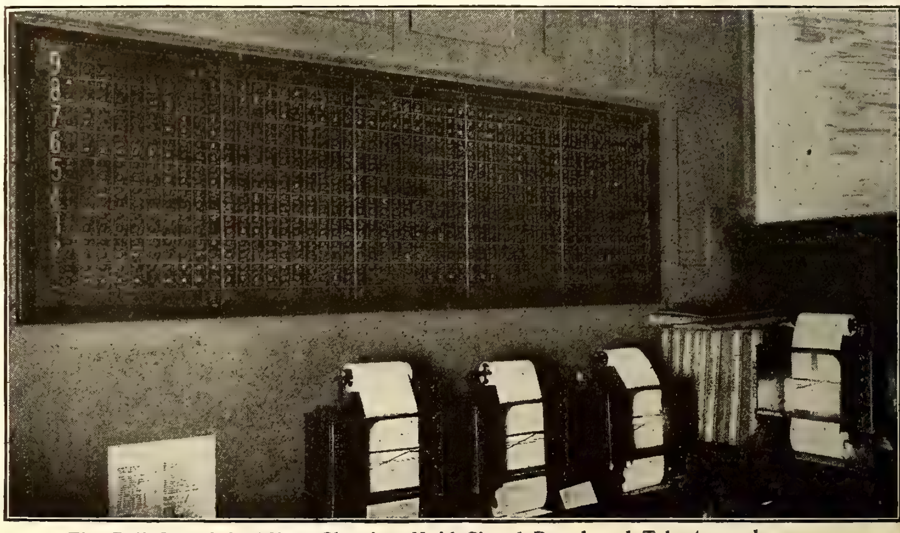
Where All Incoming and Outgoing Telephone Calls Are Answered at Hotel Astor.

Electricity performs a multitude of duties in the power plant, supplying a forced draught to the boiler fires, driving numerous pumps for water supply, filtering systems and performs dozens of other modern miracles but little known to the uninitiated.

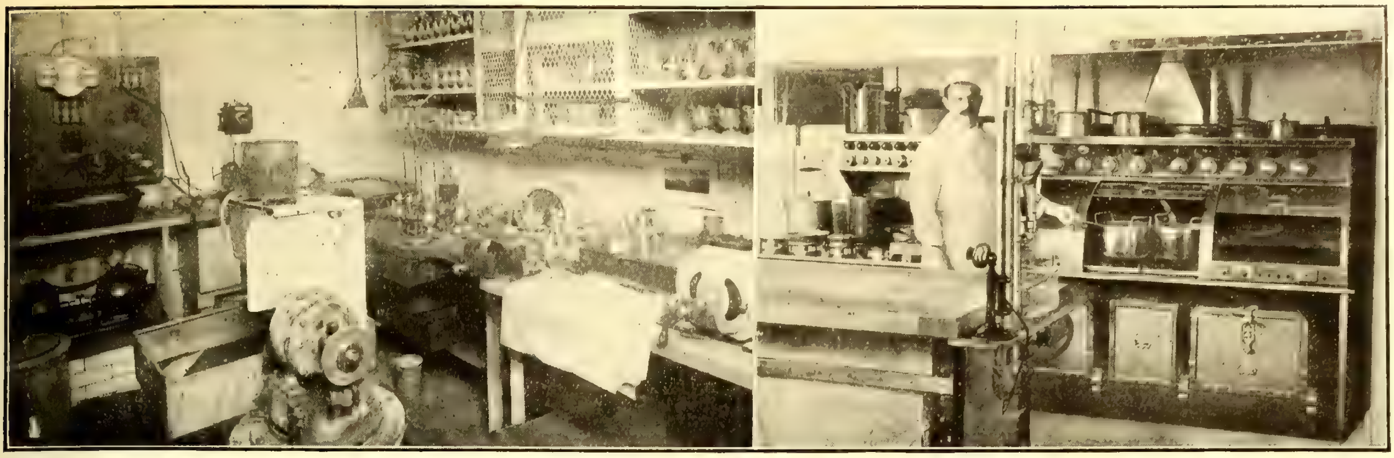
A large hotel such as this naturally requires that a good size telephone switchboard be installed, which in some instances necessitates from eight to twelve operators to handle it. This calls for a separate storage battery and motor-generator installed in the Telephone Exchange to supply the proper current for its operation.

Here also we find a very novel and efficient *Information System* installed. If an outside party calls up the local Telephone Exchange, and the person wanted is out of their room but thought to be somewhere about the hotel, then the telephone operator simply writes their name on the *telautograph,* a marvelous electrical writing instrument, and a reproducing machine at the Information Clerk's desk duplicates the signature.

The Information Clerk calls a page boy, who proceeds to call out the name of the party wanted as he proceeds over a certain definite route through the foyer, restaurant, lounge room, rathskellar, et cetera. If the party is found the page informs him that he is "wanted at the telephone." Stepping to the nearest telephone booth, the guest merely removes the receiver and says "Mr. Blank speaking—I am wanted at the telephone." The operator having charge of the booth telephones picks up the outside call from the house exchange operator and connects them with the proper booth. A record is kept of all such transactions which may be referred to at any time in the event of a dispute. If the party being paged cannot be found the Information Clerk writes this fact on his transmitting telautograph, which reproduces the message graphically before the proper telephone exchange operator. She accordingly informs the calling party that "Mr. Smith is not in the hotel. Do you wish to leave a message?" Possibly the reply is "Yes, have him call 'Plaza 406' upon his return." The operator writes this down on her telautograph together with the guest's name, her identification signature and the time the message was received. This message, received on the Information Clerk's telautograph, is detached and placed in the letter box bearing the guest's room number. All this takes but a few minutes and the telautograph makes a



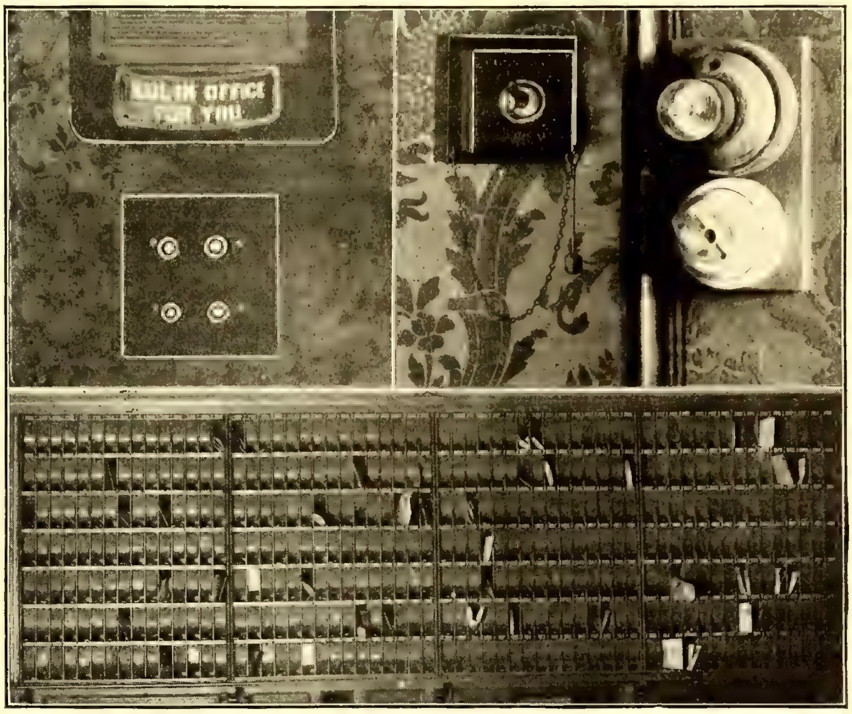
The Bell-Captain's Office, Showing Maid Signal Board and Telautographs.



At Left: a Corner of Hotel Silver Plating and Polishing Room. Right: Electric Range for Cooking.

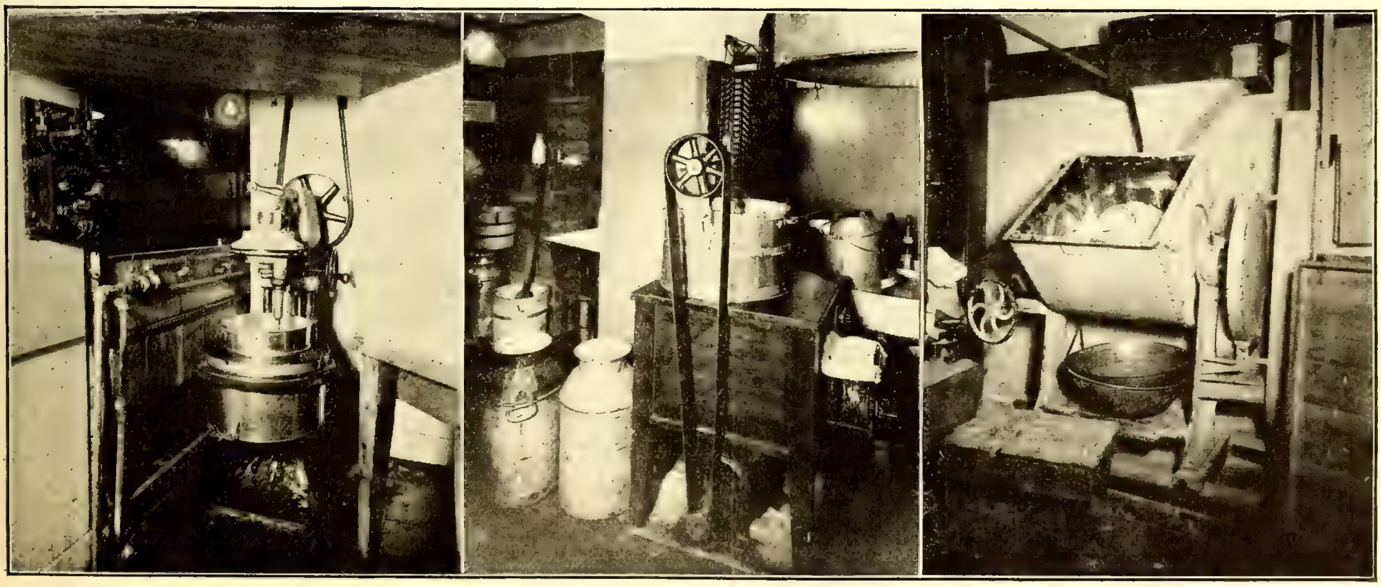
record of all paging, leaving no room for argument. If the guest happens to be in his room of course the calling party is connected at once. Otherwise the operator says: "He does not answer in his room. Do you want him paged?"

Another extremely unique feature found at the Astor is an automatic guest's room mail signal. Behind the Front Clerk's desk there is a large, finely divided rack, each division being large enough to receive a letter edgewise. A key may be placed in a pocket corresponding to a certain room number without disturbing the delicate swinging door on the front of the mail receptacle. However, if a letter or paper is placed in it, it forces the swinging cover backward and in so doing causes an electric circuit to be closed. This lights a small electric lamp in the corresponding guest's room beneath a neat glass sign which reads: *Mail in office for you.*



Upper Half, Respectively—"Mail" Announcer in Guests' Rooms, Electric Fire Alarm and "Maid" Signal Controlled by Key. Lower Half Shows "Mail" Rack Behind Clerk's Desk. Mail Announcer Is Connected with This Rack, Working Automatically.

At the Astor there is an elaborate provision made for fire protection. Suppose a fire breaks out in your room; you have three methods of notifying the proper parties: First, you may simply remove the receiver from the telephone in your room and shout "FIRE!" into the mouthpiece. Instantly and precisely several things happen throughout the building. The telephone operator receiving your brief but important message of *one word* has noted the room number from which the call has come and informs the local Fire Captain by telautograph. The alarm signal sounds in the engine room quarters where all of the fire fighting crew are located. Two specially fast electric elevators are waiting for them at the engine room floor. In an incredibly short time after an alarm is turned in and depending upon the location of the fire, a crew can be on the job. Each man carries a piece of fire-fighting apparatus (*Continued on page 362*)



In the Cook's Domain: Left to Right—Soup Mixer, Butter Machine and Bread Mixer. All Motor Driven.

Killing Sharks by Electricity*

By H. Gernsback

NOW that the man-eating shark has solidly established himself on our North Atlantic coasts—at least for the time being—it behooves us to give the new problem our serious consideration.

No longer is his existence in our northern waters denied, for scores have been caught all along the New Jersey coast as well as in bays well inland. This was proved by the man-eating shark who killed Stanley Fisher, a young boy, but a few weeks ago in Matawan Creek, one hundred yards distant from the railroad station.

Many theories have been advanced why sharks should appear so far north, but none seem very plausible. The truth is probably found in the fact that the climate around our North Atlantic shores is changing gradually, becoming warmer little by little.

Geology teaches us that thousands of years ago Northeastern America was in the grip of the ice age—the so-called Pleistocene period. Gradually the climate changed, becoming warmer an average of one or two degrees in a thousand years. Science now knows that the maximum has not been reached as yet; it keeps on getting warmer, slowly but perceptibly. In another one or two thousand years New York will probably be enjoying a semi-tropical climate. Nature as a whole works very slowly but unceasingly and the stretch of a human life is but a fraction of a second as compared to the great time-piece of nature. Hence, we hardly can tell the almost imperceptible changes occurring all the time.

Were it not for the cold Labrador ocean current coming from the north and washing our northeastern shores, we would already be enjoying a much hotter climate than is the case at present. This is best proved by the fact that New York City is under the same latitude as the cities of Lisbon, Portugal, with an average annual temperature of 60.8 degrees; Naples, Italy, with 62½ degrees; and Pekin, China, with 54 degrees. The average yearly New York temperature is but 51.7, which is so low only because of the Labrador drift.

But as stated before the climate on our North Atlantic coast is gradually becoming warmer. This is probably the reason for the present appearance of the shark, who, as a rule, is considered a tropical or at least a semi-tropical fish. That he will come back in future years is almost a certainty; do not let us delude ourselves with the idea that his present appearance is an accident, never to occur again. Nature does not work that way.

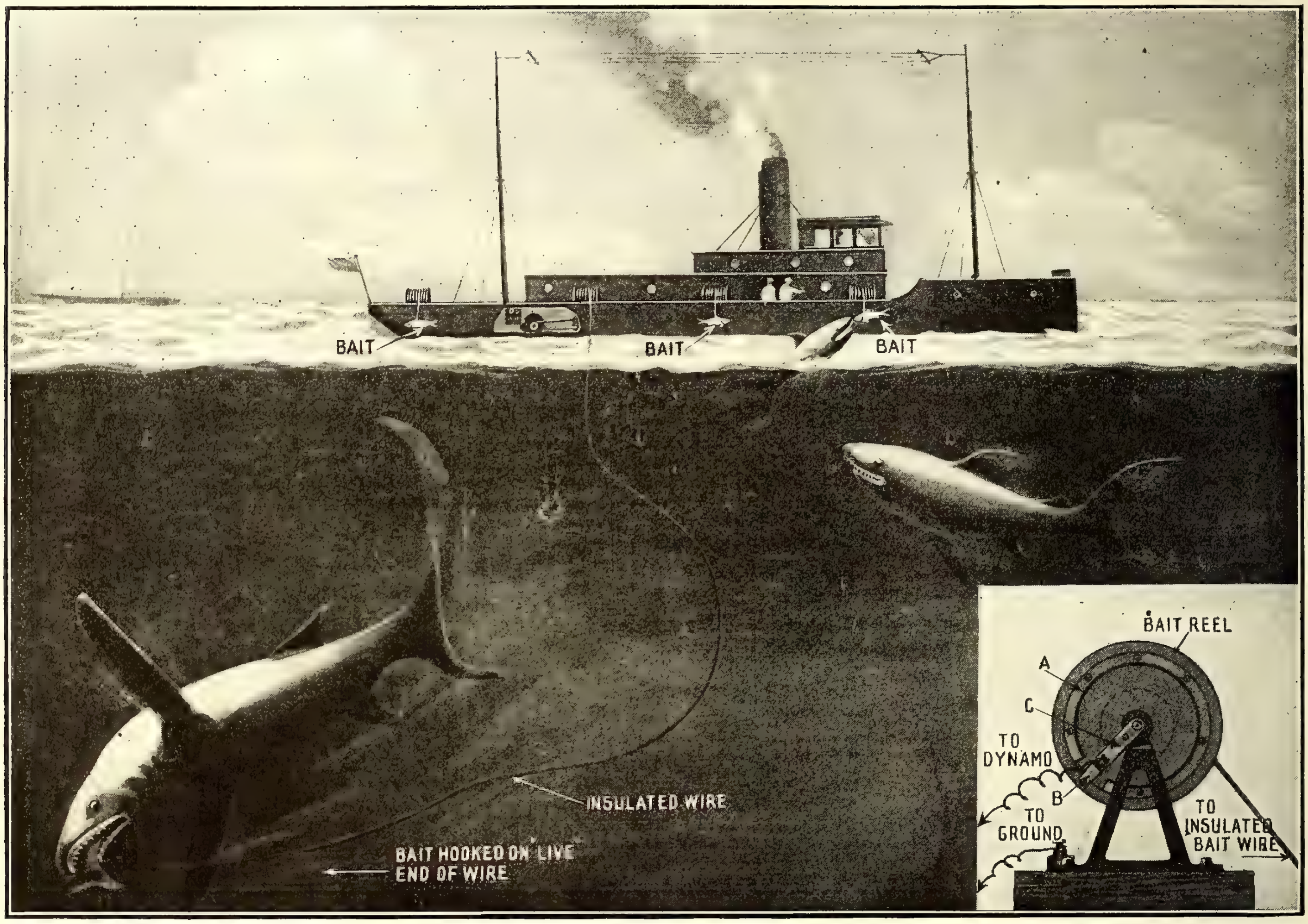
Dynamiting a few creeks and shooting at the sharks, as well as poking boat hooks at them will not worry them greatly. If this serious evil is to be at all combated, the shark must be fought systematically as well as efficiently.

The writer has given the problem his careful consideration and herewith suggests a plan which should prove effective and which if carried out systematically may result in time in frightening the sharks away from our coasts. The writer has not patented the scheme and he gives it to the public for what it is worth. The plan is eminently feasible and not at all costly.

The illustration shows the idea in a concrete manner. On each side of a small patrol-boat, bait in form of fish or meat is hung so low that it almost touches the water level. The bait is attached to an ordinary fish hook of large size which is connected to an electrical cable insulated all the way except at the point where it makes contact with the fish hook. The insulated cable (about ⅛ inch in diameter) runs to a reel the base of which is firmly attached to the boat deck in a suitable manner as shown in illustration.

Ordinarily the bait dangles close to the boat's side. Now suppose a shark, as is his custom, raises himself from the water and snaps the bait. In doing so, the shark's weight pulls down both bait and cable, which latter immediately begins to play out from the reel. Instantly, however, the electrical current is switched on automatically, as will be seen by studying the construction of the reel in the insert of the illustration. Ordinarily, no current is fed into the bait cable, which is connected with the stationary contact breaker C, insulated

(Continued on page 365)



Now That There Are "Shark" Scares Daily All Along the Atlantic Seaboard, Bathers Will Undoubtedly Hail with Delight This "Electrical Shark Annihilator" Invented by Mr. H. Gernsback. Henceforth Sharks Will Oblige Us by Electrocuting Themselves.

*This article was published originally by the N.Y. "Evening World," July 19, 1916.

The Telephone In Modern Warfare

THE signal corps in a modern army is, perhaps, the most important unit of men in the organization. Every shot made by the gun, and every move made by each soldier is practically controlled by the signal corps, that is to say, the staff officers transfer all communications from headquarters to the various posts on the fighting line by employing various kinds of signaling instruments. Some of these are familiar to our readers, as the heliograph apparatus used with the aid of the sun as a source of light, flags, lamps, telegraph and the telephone.

Fig. 4. U. S. Artillery Officer Giving Orders for Aiming and Firing of Cannon Shown in Center View, Fig. 5. Note the Compact, Loud-Speaking Telephone in Use in Both Photos. These Outfits Will Serve Also as Field Type, Buzzer Telegraph Sets. Fig. 6, At Right Shows One of the Latest Telephone Head-Sets for Aviators.

The telephone has been especially exploited for military work of late. In the past, this instrument was used very little, because it was not sufficiently perfected, but to-day there are several military type field telephones employed by different nations.

A number of concerns in this country have been developing military style telephone sets, none of which have proven superior to the portable telephone recently brought out by a New York house. The complete outfit is shown in Fig. 1. Not only is the instrument adapted for telephone service, but it also contains a military hytone, buzzer telegraph set.

This instrument consists virtually of a special loud-speaking receiver, A, enclosed in the lower compartment, Fig. 2. The horn is constructed of heavy sheet metal, substantially fastened to the receiver cap. The sound collecting instrument, or transmitter, B, is also specially built and is fastened to the case cover as the reader will perceive. The induction coil, C, is of the standard telephone type, and is supported below the cover. The power for the complete instrument is obtained from two ordinary flashlight batteries, D. These are carefully braced to the rubber support by means of a leather strap encircling both batteries. A set of four instruments comprises the complete telephone unit. The buzzer telegraph set is enclosed in the same case and supported on the same board. The buzzer, F, is of the standard high-frequency type, and is connected in series with a small telegraph key, E. This consists of two levers, one on the opposite side as can be seen in Fig. 3, which is a back view of the complete unit. The power for the buzzer telegraph is obtained from the same two flashlight batteries which supply current to the telephone. The main line consists of a rubber-covered wire, fitted at the ends with special jack plugs, similar to the ones used on a modern telephone switchboard. These plugs are fitted in a socket, Fig. 2-G, which connects the instrument with the distant party with whom communication is desired.

The cover upon which the transmitter is fastened contains two springs, H, so arranged that when it is raised to the position shown it will perform three functions: first to disconnect the telegraph key, E, from the main circuit—second, to put the telephone transmitter into the circuit so that telephonic conversation may be carried on—and third, to hold the cover in place, so that the officer using the outfit can speak into the transmitter without the inconvenience of holding the instrument in a certain position.

When telegraphic conversation is desired, the operator in charge of the apparatus plugs in with the party to whom he wants to talk, and leaves the transmitter cover down. The key circuit is thus put in operation. The telephone receiver is also connected with the buzzer circuit so that a loud sound is produced when the messages are being sent. With such an arrangement the outside noises, such as those produced by the firing of cannon, are thus overcome by the large volume of sound produced by the receiver. It has been shown by actual test that signals can be plainly read at a distance of 30 feet from the instrument during gun fire. Fig. 4 shows a United States officer of the

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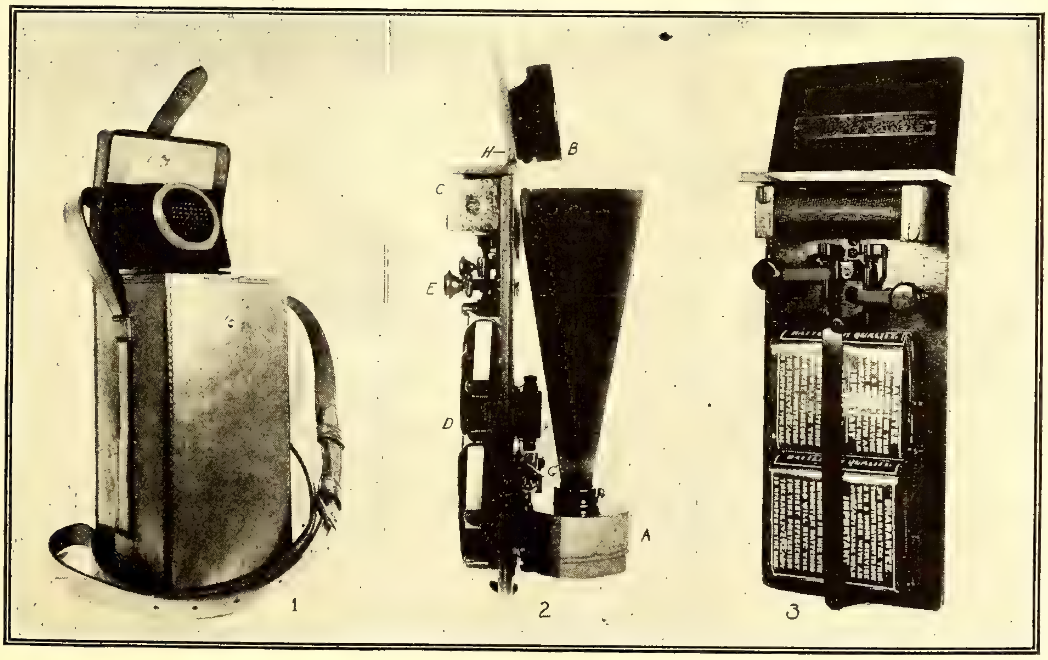


Figs. 1, 2 and 3, Illustrating the Latest Military Loud-Speaking Telephone and Buzzer Telegraph Outfit. Rugged and Simple in Design and Construction. Works on Flashlight Batteries. Rising Lid Makes Connections.

Electricity Direct from Sunlight

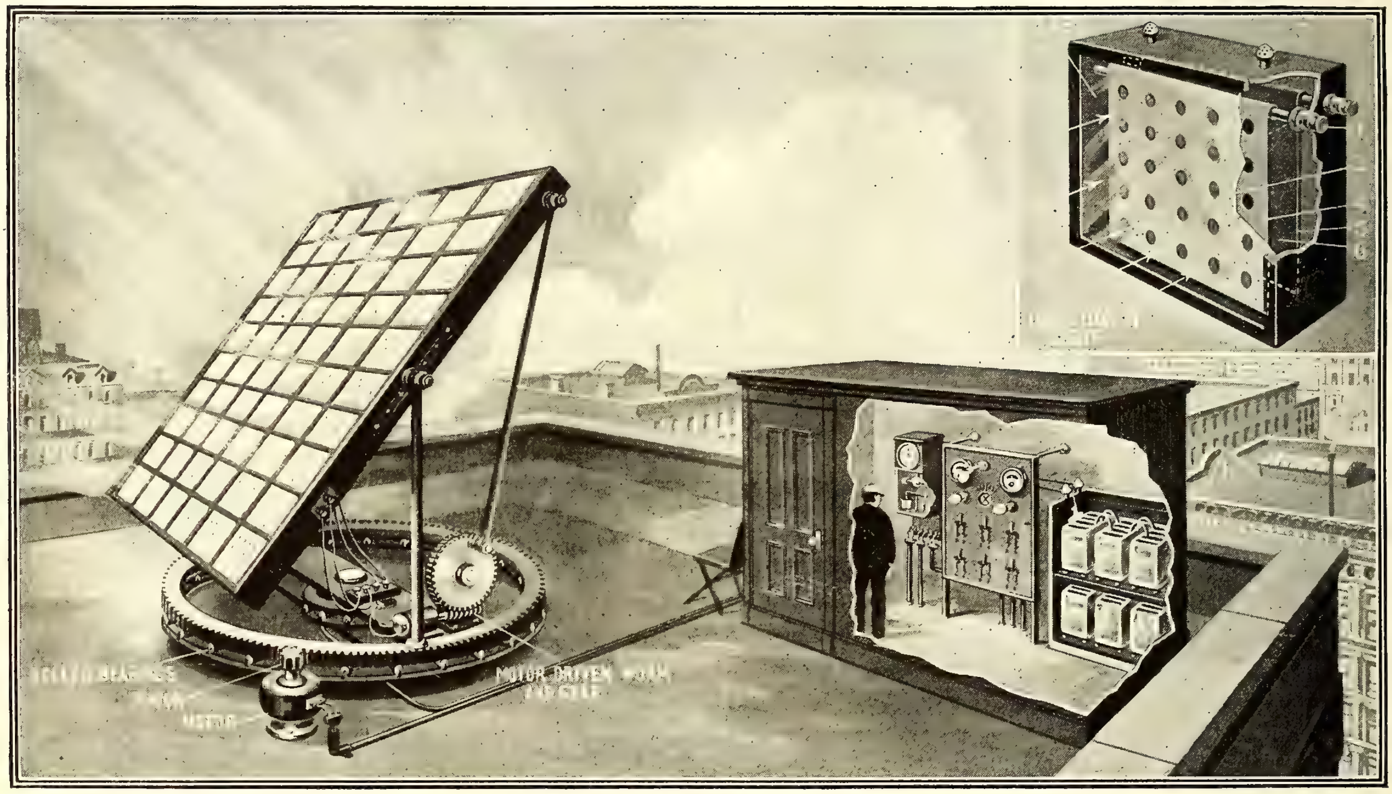
EVERYTIME you walk, sit, or stand in the sunshine for one minute, you are unconsciously the recipient of about one and two-thirds horsepower in solar energy. In watts this is equivalent to 1,246 enough to light approximately twenty-five 50-watt tungsten lamps. Again this amount of energy might turn a motor-driven churn, ice-cream freezer or a dozen other useful devices. These figures are based upon the fact that the solar energy reaching the earth's surface is equivalent to 5,539 foot pounds per minute at midday, for every square foot of surface exposed to the light. This is equivalent to .167 horsepower or 124.58 watts per square foot per minute. In other words when you think it is a hot day and the perspiration is streaming down your face, it really is *hot!* For every square inch or a spot on your head but little larger than a postage stamp there is being received .0494 B.T.U. (British Thermal Unit) per minute, and *one* of these B.T.U.'s represent enough heat energy to raise the temperature of 1 pound of pure water 1 degree Fahrenheit at or near the maximum density of the water.

Such being the case, it is small wonder that a straw hat proves a god-send to us poor mortals who must, perchance, stroll in the sunlight during the summer months. The top of your head, if uncovered, will receive solar energy to the value of 3.96 B.T.U.; sufficient heat to raise the temperature of 3.96 pounds of water 1 degree Fahrenheit. The active solar area of the average person approximates 10 square feet. Thus when you lie stretched out on the beach, Old Sol will be shooting his rays at you to the tune of 71.20 B.T.U.'s a minute. This means that every square inch of the body exposed to the sun's rays receives potentially an amount of energy of something like .86 watt per minute. This means one candlepower of light figuring on the new gas filled tungsten lamp as a basis.

These astounding facts may seem somewhat alarming to some of us and the question naturally arises—what becomes of all this energy and the resultant heat? True, we feel the heat on a sultry summer day, but not all of it. The figures cited above are scientifically accurate, but all of the energy falling on the surface of a body in the form of radiant light is not available when transformed into heat or other forms of energy, as electrical, for example. Only a fraction of the theoretical solar energy reaching the earth's surface is effective as work-producing power, due principally to heat radiation and other factors. The hair of the head, for instance, helps to dissipate the energy of the sun's rays, one answer to the query—I heard it coming—why didn't the Indians wear hats? Who ever heard of a bald-headed Indian?

Well, as we have just learned it is not possible to utilize all the energy in the sun's rays for practical work-a-day requirements. However, some of our philosophers have thought well enough of our friend—the sun—to bend their energies in the direction of perfecting a device or scheme whereby man may be emancipated from some of his earthly troubles. Imagine a solar generator resembling a miniature hotbed, like those you sprout plants in, placed on your roof or in the back yard, and under the glass, instead of dirt, a series of electrolytic cells, the whole affair arranged to revolve slowly so as to be at right angles at all times to the sun's rays. The energy in these rays, including those which we do not see, has thus been applied to the direct production of electricity by Mr. Theodore W. Case and recently described by him before the New York Electrical Society. In the first experiments a small cork was wound with copper wire, the coils not touching, and between these coils was wound a silver wire, coated with silver bromide, but not in contact with the other wire. The two terminals of the wires were connected with a pair of sensitive high resistance wireless 'phones. The cork, supporting the coils of wire, was placed under a very small stream of tap water, which was allowed to run over it, the whole forming an electric cell or battery. A strong beam of intermittent light was then concentrated upon the wire on the cork. A distinct note was heard on the wireless receiver, due to a current generated in this cell of copper and silver bromide in tap water. It was then decided to try shielding the silver bromide wire on the cork from the light, leaving only the copper wire exposed. The result was most surprising in that the note was distinctly heard on the receivers, due to the intermittent light which fell upon the cell. Again, however, the note would sometimes be heard and sometimes not. Next, the copper wire on the cork was shielded from the light, the silver bromide wire now being exposed to the light. With this experiment no sound was heard under any conditions. The result then indicated, without doubt, that the reaction was due to the effect of light on the copper wire, and that the silver bromide electrode acted only as the other electrode, being of no importance in other respects.

A new cell was then made by winding the cork with two copper wires, opposed to each other, as electrodes, under the tap water. When both copper wires were exposed to the intermittent light, naturally no results were obtained; but, upon shielding one of the copper wires from the light a note was again heard in the receivers. The conclusion was then reached that the cop-



A Solar-Electric Generating Plant May Be Available in the Not-Far-Distant Future, Which, When Installed on the Roof, Will Cause Light-Active Cells to Rotate and Align Themselves at Right Angles to the Sun's Rays at all Times. The Electric Energy May Be Stored in Storage Batteries So As to Be Available at Night. Insert Detail of Single Cell Shows Two Copper Plates, 4 and 5, Immersed In a Salt Water Solution 6; 3 Is Glass, While Gas Vents Appear at 7. Electric Terminals at 1 and 2.

per wire, under the influence of the intermittent light, must be producing the current. But, as before, this arrangement would work at times, and not at others. It was then found that this was due to the fact that some parts of the copper wire used were oxidized and other parts were not. One of the copper wires was then thoroughly cleaned with fine emery paper and the other copper wire was highly oxidized in a Bunsen flame before being wound on the cork. With this construction the notes on the telephone were far louder than before.

As soon as it was found that the copper oxide electrode was the one that had been reacting, a larger cell was constructed, consisting of two copper plates, instead of wires, both plates, oxidized in a flame, immersed in tap water and placed one back of the other, with light shining on the front plate. This cell was connected to a galvanometer of 200 ohms resistance. The back plate, or the one shielded from the light, acted as the zinc plate in an ordinary battery. Sodium chloride (common table salt) was put into the water to reduce the internal resistance, and a much stronger current was produced. In bright sunlight, a deflection of 45° to 50° was noted. When the light was thrown on what was formerly the back plate, the previously exposed front plate would, while in the dark, act as the zinc. In other words the plate in the dark always acts as the zinc.

Several larger cells were then constructed 4"x3" in round glass jars, one plate placed back of the other; the front plate burned in a flame to copper oxide until the surface was black, and the back plate polished copper. The glass cells were then placed in wooden boxes, excluding all light, with a door opening in front. Some of these cells were tested for over three months, and they seemed to react as well at the finish as in the beginning.

Next the action of polished copper plates, not oxidized, was tried in the salt solution, under the influence of light. The plate exposed to the light gradually, during fifteen to twenty minutes, changed to a reddish color; then quickly to a very dark purple, and finally, to a grayish black. This cell was then tried with a galvanometer and found in its reaction similar to the above cells in which the front plates were oxidized in the flame, except that the reaction was very much weaker; and, so far, no better results than 4 or 5 degrees on the galvanometer have been obtained. The back plate acts as the zinc, and the cell is in every way, except in intensity of reaction, similar to the cells which have oxidized plates. The polished copper plates do not turn this dark purple except under the influence of light. However, polished copper immersed in a salt solution will turn a reddish tint in the dark, which was taken to be copper oxide; then, if exposed to light, will turn to dark purple, which is assumed to be a higher oxide. Only when this cell is short-circuited does the back plate undergo a marked change of appearance; it then grows darker in color, although it always remains of a much lighter shade than the front plate which is being exposed to light.

To return to the cell in which the front plate is oxidized in a flame and the back plate is polished copper, some of its peculiarities proved very interesting. If left short-circuited in the dark while not in use, the efficiency of the light reaction is greater upon exposure than when left open-circuited while not in use. Upon exposure of the front plate to light the reaction is practically instantaneous. However, after the rapid upward swing of the needle, there is a continuous slow upward swing, lasting a few seconds, before the complete swing is reached. If the light be left on for a short time, fatigue is noticeable. This, at present, cannot be explained, but it may be due to the absorption of gases. In this fatigue, however, the galvanometer needle only drops a few degrees and then seems to remain there. If the cell be rested in the dark, recovery is then evident upon again exposing the cell to light.

If light be cut off from the cell, the needle drops quickly for a few degrees only. Assume the reading to be 40° on the galvanometer when first exposed to the light; then the light be shut off, the needle wil drop to 15° almost instantly; but from 15° to zero, it will drop slowly, due to some after effect. The needle will finally come to zero within two or three minutes; then, in most cells, will reverse three or four degrees; then come to zero and remain there. The reversibility in the dark, after exposure, seems to depend upon the strength of the sodium chloride (salt) solution, for zero is reached almost instantly in a very dense solution, but much more slowly, as above described, in weaker solutions.

HARNESSING the sun's energy is by no means a new idea. Many scientists all over the world have for years worked on this fascinating problem. Do you know that on a clear, sunshiny day, the sun's rays beat down on every square inch of your head with enough energy to light a one candle-power, nitrogen filled, tungsten lamp? This and many other interesting facts are described in this article. The new photo-electric cell recently invented by Mr. T. W. Case should, therefore, prove of more than passing interest. While the current obtained is rather weak, Mr. Case has opened a new field to us which may soon prove commercially practical.

The output of the cell depends upon the strength of the salt solution. The weaker the solution, up to a certain point, the better the results. For instance: 1.005 Beaumé specific gravity of electrolyte gives the best result. A cell 3"x4" gives 1/10 of a volt in sunlight and about 1/2000 of an ampere. Upon increasing the strength of the salt solution the amperes increase, as would be expected in lessening the internal resistance of the cell; but the voltage drops quickly.

An interesting fact, noted later, shows that when the electrodes are covered with several coats of white paint, or bath enamel, the cell acts; indicating that perhaps some of the invisible rays are also effective. If heavily coated, however, no action ensues. Passing the light through water, however, the cutting off the heat rays, made no appreciable difference in the voltage or current.

Regarding the intensity of light, it was found that ordinary diffused daylight works extremely well on this cell. For instance: with the same galvanometer, on a cloudy day with diffused light, 10° reading was noted on opening the door of the cell; whereas, intense sunlight gave 40° to 50°, a difference in reading which was only four or five times as great as compared to the much greater intensity of sunlight over the diffused daylight on a cloudy day.

Next, in regard to the voltage in different intensities of light. The voltage will stand at a higher point in intense light when being drawn upon, than it will when being drawn upon in a lower intensity of light. However, if the cell be exposed at a very low intensity of light, without being drawn upon, the voltage will rise to nearly as high a point as in intense sunlight; but when being drawn upon, it takes a higher intensity of light to hold the voltage higher.

The amperes, of course, are increased with the area of the plates, providing the plates are evenly oxidized and evenly exposed. Otherwise, local currents will be set up.

Better results are obtained if the back of the exposed plate be heavily painted or enameled, or insulated in some way; so that no local action will occur between the front of the exposed plate and its back.

If several cells be connected in series the voltage increases; and if several of the cells be connected in multiple, the amperes increase. This is what would be indicated in any theory.

When these cells are newly made, if they are left in the dark, say over night, before being used, the cells will act much better the next morning than when first made and will continue to do so thereafter.

During experiments conducted in Florida with some of these photoelectric cells a voltage of 1/10 and an amperage of 2/10 was obtained. It was found best to heavily coat the back of the front plate with some non-conducting material, also the front plate is preferably perforated with a number of small holes to lower the internal resistance of the cell as shown in

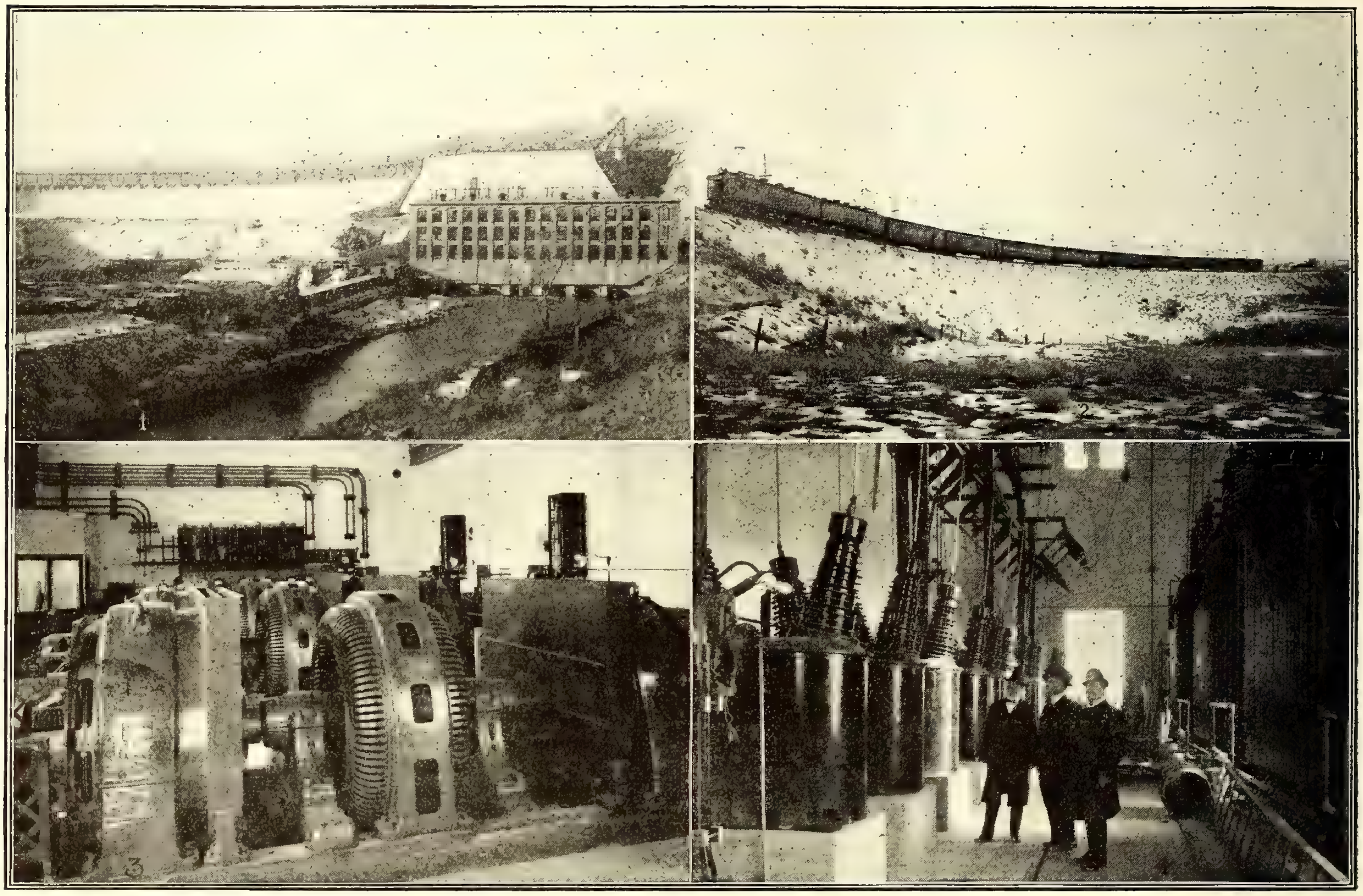
(Continued on page 370)

The Dawn of Electrical Railroading

IT is not so many years ago since the good people of Pennsylvania were completely flabbergasted by the sight of a steam locomotive as it wended its way at a snail's pace through the valleys of Quakerland. Its progress was, at all events, slow and tortuous and there was a slight risk of exceeding State or municipal speed laws, for this early prototype of the modern Goliath of the rails did not proceed at a more astonishing velocity than four miles per hour. This speed is on par with that of the average pedestrian, as is well known, and it is really nothing short of marvelous to contemplate for one moment the broad strides attained in modern railroading. Luxurious Pullmans and sleepers now roll across the one time wild and uninhabited prairie, and on across the towering Rockies to the Pacific Coast.

This wonderful development is pictured in the accompanying views, Figs. 1 to 4, which show to some extent the mighty machinery and forces of nature brought into play in working out this stupendous undertaking. All those who have traveled even to a slight extent on steam driven railroad trains, have undoubtedly been annoyed during the summer months by the ashes, smoke and gas wafted back through the open windows of the speeding train, and appreciate fully the immeasurable advantages accruing from the use of electrical energy in driving trains. Besides, the electrical method is, in every way more efficient, both from the economical and operating standpoint and the point of flexibility of control and distribution.

This wonderful electrified transportation system passes through some of the most in some of the most isolated sections of the country. The 100,000 volt transmission lines feed the sub-stations and in each the current is passed through massive oil switches and step-down transformers (see Fig. 4), in which operation the potential of the electrical energy is reduced to 2,300 volts A.C. The current from the transformers, after being reduced as just mentioned, passes through the proper control apparatus and switches to the motor-generator sets. These motor-generators, of which there are from two to three in every sub-station, comprise a 60-cycle synchronous A.C. motor, driving two direct current generators, each of which develops 1,500 volts D.C. The two D.C. machines are permanently connected in series, thus delivering a direct current potential of 3,000 volts, which is said to be the highest



Views Along Newly Electrified Chicago, Milwaukee and St. Paul Railway Running from Avery, Idaho, Over the Great Continental Divide to Harlowton, Mont., a Distance of 440 Miles. The Electric Power is Transmitted Over the Route at a Pressure of 100,000 Volts. The Locomotives Are the Most Powerful Ever Built as They Have to Climb Mountain Grades

It has taken electricity many years in its efforts to supersede the steam-driven monster that to-day spirits us homeward or vacation bound for distances of a thousand miles or more. In the past ten years, however, electrical railway engineering has developed with rapid strides, and a number of the more progressive and up to date railroads have given this form of power a thorough trial. Very few railroads which have tried it out properly have so far discarded it. One of the latest railroad electrifications over mountainous country, and a credit to the engineers who built it, is that vast trackage owned by the Chicago, Milwaukee and St. Paul Railway, stretching from Avery, Idaho, over the great Continental Divide to Harlowton, Mont., a distance of 440 miles. gorgeous scenery on the Continent and every luxury is assured travelers in the superb trans-continental all-steel flyers which traverse this system under the names of the *Olympian* and the *Columbian*.

In Fig. 1 there is shown the mighty dam erected at Great Falls, Mont., where high pressure water turbines are installed to drive powerful alternating current generators, which deliver thousands of electrical horse power of energy at a pressure of 100,000 volts. Along the electrified system there are distributed fourteen sub-stations, each of which, complete, costs about $160,000. Each sub-station is about thirty-three miles from its neighbor. The railroad company has built substantial and artistic living quarters for the sub-station employees, who live along the railroad lines direct current potential ever adopted for railroad work in the world. The interior of one of the sub-stations is shown in Fig. 3. The synchronous alternating current motor is mounted mid-way on a common bed-plate, while the two D.C. generators are rigidly secured on either end of the central shaft. Thus all three machines on the common bed-plate are driven at a constant speed and operate with the maximum mechanical and electrical efficiency.

The 3,000 volt direct current, after it leaves the sub-station switches, passes along the trolley cables, suspended over the track. It is led through specially designed pantagraph trolleys on the roofs of the locomotives, as the reader will perceive in Fig. 2 The electric locomotive shown in this fig-

(*Continued on page 370*)

Why Not Have the President Talk Simultaneously to "All the People?"

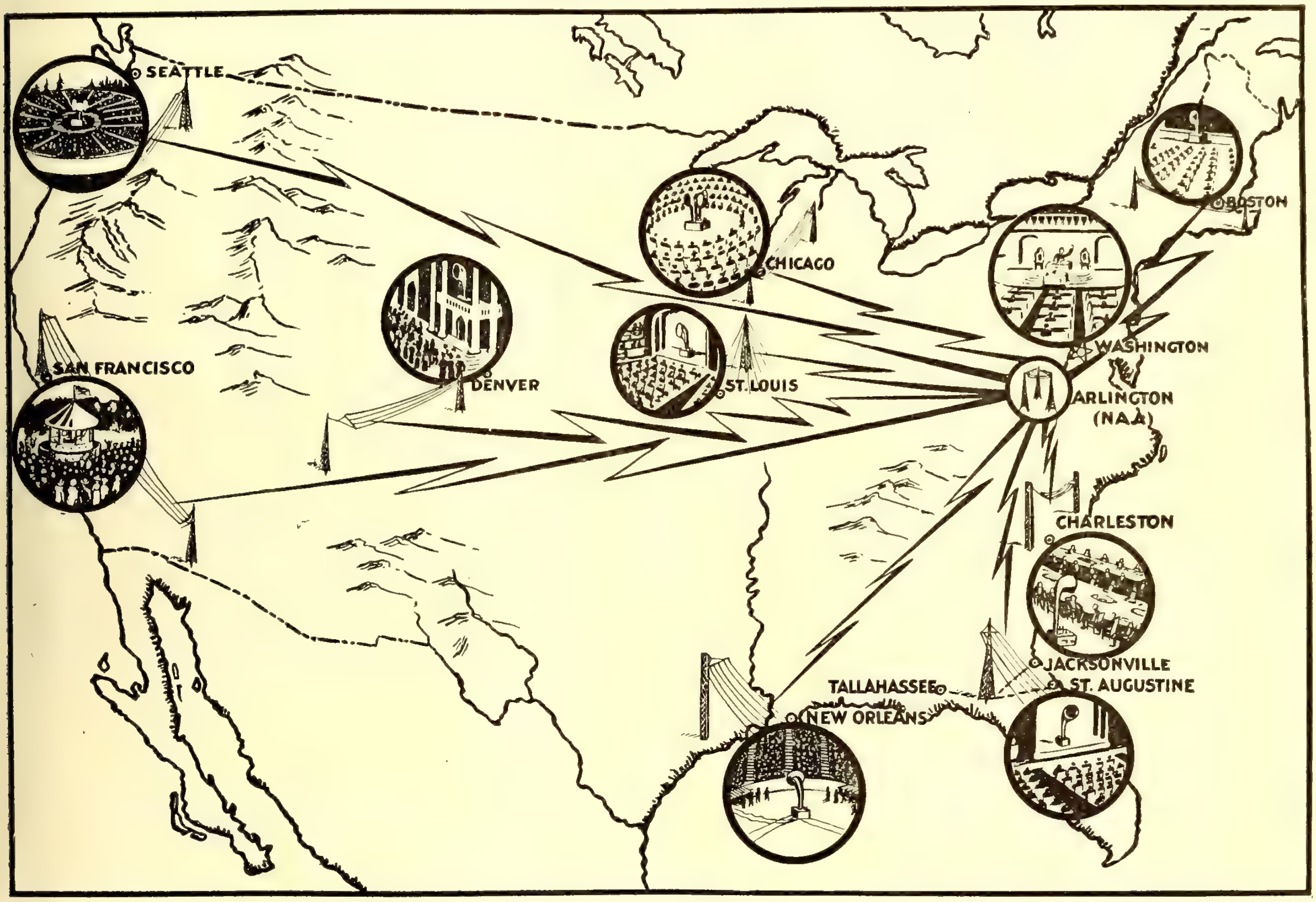
SSH.............h!!! "All ye, The People of the United States: his Excellency, the PRESIDENT!" This greeting may be heard all over the country, in the not-far-distant future, and not on a phonograph either, if Mr. Paul Calhoun's dream comes true. His idea is to link up all the larger cities and towns by radio with the powerful transcontinental government wireless station at Arlington, near Washington, so that when the President makes a speech before Congress or even his inaugural address, *all the people* can hear it, instead of a select few gathered within ordinary hearing distance of the speaker as has been the case in the past.

Such a scheme as this does not belong wholly to the realm of idle dreams and the practical applications and tests already made with long distance radio-telephony from the powerful Arlington station controlled by the government, have proven that a man's voice can be flung afar, through the all-pervading ether from Washington to Honolulu, 4,900 miles. So, if such an idea as the one outlined here, is to be put into effect it would seem a not very difficult matter to ensure its emphatic success.

In the radio telephonic tests conducted a few months ago, the wirelessly transmitted voice waves were caught on an antenna in the usual way and then transformed into pulsating electric currents, which passed over the regular wire circuit several miles long. Thus it has been found practical to transfer the spoken voice from a standard telephone circuit through a wireless station, across great distances by etheric waves, and back again into undulating electric currents passing over a metallic wire circuit.

As the illustration shows, it would be possible to have the President make his speech in the usual way in the Capitol at Washington, and have the voice waves picked up by a battery of sensitive microphones, located at the speaker's desk. These would proceed to transform the voice vibrations into undulating electric currents, passing over a wire circuit to the radio station at Arlington. Here, by means of a sensitive vacuum tube control as used in the last memorable radio-telephonic test, the voice waves in the form of fluctuating electric currents of ordinary amplitude, would be amplified in power and propagated from the great antenna of the Arlington station with the power of several hundred horses. These oscillations would fly through space at a velocity of 186,000 miles per second, and thus would take but the fraction of a second to traverse the intervening space between Washington and San Francisco, or Honolulu, for that matter.

As our artist has endeavored to show, the President's speech as received by radio in all the large cities throughout the country would be amplified if necessary through the apparatus, provided with large horns, so that an entire theater audience could hear the words distinctly. The receiving apparatus could be placed outside of public buildings, too, when desired. Not only would it be possible for those in such privileged locations to hear the President's words, but all amateur radio stations, of which there are many thousands throughout the country, could receive the message as well. Undoubtedly this plan will be tried out in the near future. It would seem a very patriotic and inspiring idea to carry this out during the next presidential inauguration exercises at Washington, in March, 1917.



A Remarkable Yet Perfectly Feasible Scheme Recently Suggested Whereby the President's Speeches May Be Heard Simultaneously All Over the United States. The Voice Waves at Washington Are Flashed by Radio from Arlington, Picked Up by Radio Receptors and Amplified so That a Large Audience Can Hear Every Word.

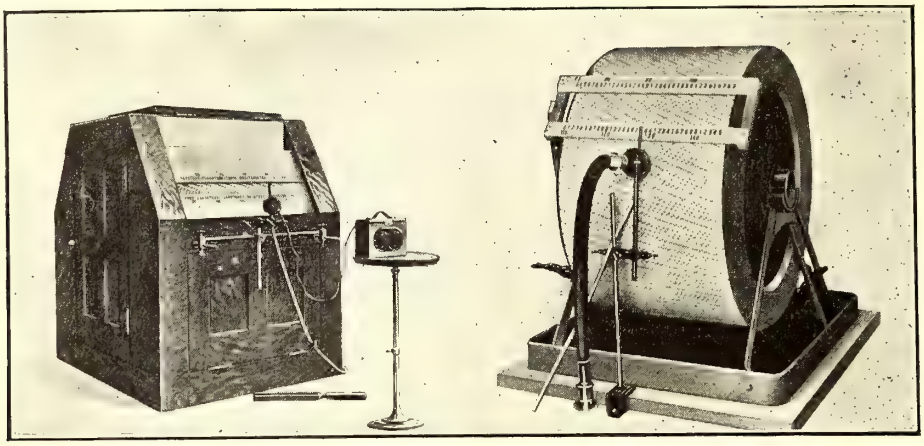
ELECTROLYTIC IRON FROM CAST IRON.

According to *The Electrician*, a certain French foundry is now producing tubes and sheets of electrolytic iron by a process in which ordinary cast iron serves as a base, while the product consists of iron in a very pure state. The cathode rotates in a solution of ferrous salt so as to have a layer of iron deposited on the surface. The solution is kept neutral by placing iron turnings in the bottom of the tank and by adding oxide of iron as a depolarizer. The iron thus produced is very hard at first, and contains some gas; it is then annealed in order to expel the gas and produces a soft, malleable metal. Iron pipe can be made directly by using a rod as a core, but the manufacture of sheet iron is not yet in a commercial state, though they expect to produce, without rolling, sheets of very soft and pure iron which will be very valuable for electrical machinery.

Of the 13,000,000,000 kilowatt-hours recorded 70 per cent. of all the central-station energy of the country is being generated by a few companies, representing a saving of approximately 15,000,000 tons of coal.

Timing the Frequency of Musical and Vocal Sounds

IN experimental psychology, instruments have as a rule been designed to meet immediate needs, and have usually been described incidentally in reporting the results of psychological investigations. Much research has been wasted because done with untried apparatus. In fact most of our in-



Simply Sing a Note Before the Mouthpiece of the "Tonoscope" and It Will Indicate Visually the Exact Frequency of the Note. It Is Also Applicable to Musical Instruments.

PROBABLY and quite possibly you sing or play a musical instrument. All well and good, but do you run the scale or strike each note accurately? To ascertain whether you do or not is the special function performed by the latest triumph in scientific musical devices—the Tonoscope—a really wonderful instrument that indicates visually just what note you are singing or playing and the exact vibration frequency of that particular note. Read how Prof. Carl E. Seashore settled a pitch discrepancy argument in a symphony orchestra as to whether the oboe or French horn player was off the key.

Also how a certain vocal soloist had a tendency to flat relatively high notes. The Tonoscope demonstrated the error and the singer learned to correct the note. The instrument seems to possess superior merit in psychological research.

struments are in a crude condition; and many fields of investigation lie untouched for want of measuring instruments. It is a sign of a higher stage in the science that the most essential psychological instruments are now being subjected to investigation apart from the specific pending psychological use. Only in this way can we properly develop instruments and standardize the technique of manipulation, writes Prof. Carl E. Seashore, in *The Psychological Monographs.*

The tonoscope, one of the latest important acquisitions of science, works on the principle of stroboscopic vision, the principle of moving pictures. Auditory vibrations of air, caused by voice or musical instrument, are converted directly and instantaneously into visual configurations on a screen, and the *vibration frequency* which denotes the pitch of the tone may be seen in plain figures on a scale. This enables us to measure the pitch of any tone by direct inspection while singing, speaking, or playing under normal conditions. The ability to do this opens up countless problems in the psychology of tonal expression.

In moving pictures it is well known that, if we have successive pictures which are alike thrown on the screen in the same place and in rapid succession, they form one continuous picture which stands out clear and still. This is the principle here employed. The revolving screen, rotating at the rate of one revolution per second, carries rows of dots, regularly spaced but varying in number for each row. When a tone is sounded, the row which has the dot-frequency that corresponds to the vibration-frequency of the tone will stand still and be clear while all other dots move and tend to blur. Each row runs under a number on the scale. The row which stands still, therefore, points to a number which designates the pitch of the tone. The screen contains a sufficient number of rows of dots, varying in number, to correspond directly, or by multiple, to all tones within the range of the voice. To see the pitch of the tone one has therefore only to see the number of the line that stands still.

The essential features making up the Tonoscope in turn are the speed regulation, the screen, the dot grouping, the sensitive light and sound transmitter, and the siren.

The validity of stroboscopic frequency measurements depends upon the accuracy with which the movement of the exposed object is controlled. The method employed in the early models proved entirely too laborious and inconvenient. The final solution was found in the use of a synchonous electric motor which drives the drum (screen) at a regulated and constant speed.

A motor of this type is mounted on the main shaft of the tonoscope drum. The drum, serving as a balance wheel and being connected to the motor by a coil spring, furnishes the right degree of inertia and flexibility in the transfer of the pull.

A large 10 v.d. tuning fork is used as an interrupter. It is energized by primary cells, and is encased in a box which is kept out of the way in a closet so that no noise shall come from it. A 16 c.p. lamp used for resistance in the motor circuit, is mounted between the prongs of the fork and proves a convenient means of keeping it at a sufficiently constant temperature, the temperature being that to which the fork is raised by the heat of the lamp within the box.

A 110 volt direct current is completed through the motor and a mercury contact interrupted by the fork. The current is reduced by the lamp resistance. The make-and-break is short-circuited with a condenser to avoid forming of an arc. A large amplitude of the fork, fully 10 mm., also helps in preventing the tendency to arc.

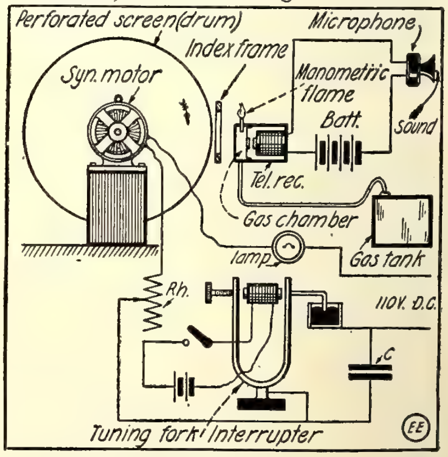
A rheostat inside the tonoscope case, with a switch on the surface, serves for the adjustment of current, as there may be fluctuations in the supply main. A small detachable crank for starting fits the end of the main shaft which comes out flush with the edge of the case on the side. To start the tonoscope one has only to start the fork, give the drum a turn up to approximately one revolution per second and close the switch. Once started, the instrument will run indefinitely and there is no care or distraction in the running of it.

The rotary stroboscopic screen is formed by mounting a sheet of aluminum in the shape of a large drum over a heavy balance wheel. A section of this drum is seen through the opening on the front of the case. (See Figure.) This screen is 50 cm. wide and has a circumference of 242 cm. The balance wheel is heavily mounted on ball-bearings resting on a heavy iron frame. The whole instrument is enclosed in an oak case with doors on every side.

The size of the drum is determined by the minimum area for the legible distribution of 18,500 markings, or stroboscopic dots. In the present screen the dots are bored holes, three and one-half mm. in diameter. The inside of the drum being dark, the holes show up clearly as black spots on the light aluminum surface. These holes are spaced with the highest mechanical accuracy and are arranged in 110 parallel rows, each completing the circumference of the drum in uniform spacings for each row (Cf. arrangement of dots in screen in cut). One row has 110 dots and the dot frequency in the remaining rows increases by one dot for each row up to and including 219. Thus we get frequencies to correspond to each integral vibration frequency in an octave of tones, the octave of 110 v.d. to 220 v.d. This is approximately from *A* up to the *a* below middle *c*.

This octave was chosen after much experimenting as being the most serviceable, all factors taken into consideration. Within this octave the tones are read directly, and above and below it they are read by multiples. The number of holes in each row is shown in plain large figures on the scale. When the drum revolves the row formation stands out clearly and each row points to a number.

As may be seen there is an upper and lower scale, one on each edge of the shield.



Details of "Tonoscope" Mechanism, Including Tuning Fork Interrupter for Synchronous Driving Motor.

It is necessary that the holes should be large enough to be easily legible under the

(*Continued on page 371*)

MICHAEL FARADAY.

September Marks His 125th Birthday Anniversary.

Born Sept. 22, 1791—Died Aug. 25, 1867.

Michael Faraday was born September 22, 1791, at Newington Butts, near London, England. His father was a blacksmith. Faraday when quite young, began to learn the trade of bookbinding, at which he worked until he was about twenty-two years old. He studied there, with the greatest interest, all the books he could obtain, especially books dealing with chemistry and physics. Those book undoubtedly awakened his interest in electricity.

Later he heard of the great invention of Sir Humphrey Davy, and went to London to hear a lecture delivered by Davy, before the Royal Institution of London, on his arc light. When introduced to Davy, in 1831, he at once employed Faraday as an assistant in his laboratory. He then threw himself with great energy into the study of physics and chemistry, and after a short time became Davy's secretary.

In the year 1827 he was made professor of chemistry of the Royal Institution in London, and from the year 1829 to 1842 he was also employed as a teacher in the Academy of Woolwich. He died August 25, 1867, at Hampton Courts.

Faraday, to whom we are indebted for the discovery of electro-magnetic induction, and a great many other far-reaching electrical inventions, was one of the world's greatest scientists. As for his original inventions, his genius has never been surpassed by any living scientist.

Michael Faraday, Discoverer of Electro-Magnetic Induction. One of the World's Most Famous Electricians.

It must be remembered that practically all of the important electrical appliances, which to-day are almost necessary to our life, have been developed from Faraday's discoveries. Telegraphy, telephony, all regulating mechanisms and the dynamo, are all due to Faraday's wonderful research work on electro-magnetic induction.

The discovery of the electro-magnetic induction was not due to luck or chance, but was the result of logical reasoning. Already Ampère's theory seemed to indicate the existence of such a phenomenon. However, Ampère, notwithstanding his great keenness in deduction, was not able to advise the proper means of demonstrating it. Faraday, himself, as early as the year 1825, tried to perfect a device which would produce current in a circuit which was not connected to any source of current; but not until 1831 was he able to prove his theories. The form in which the effect was found, was altogether different from what the scientist had thought or expected.

He found that the moment a circuit was closed a momentary current in an opposite direction would be produced in an adjacent wire. This, however, was sufficient for Faraday to deduce the problem within a very short time. Even the induction due to the residual magnetism did not remain hidden from his keen insight.

THE X-RAY IN MODERN INDUSTRY.

After the discovery of the properties of the X-Ray by Professor Röntgen, people realized the importance of these rays for therapeutic and medical work. However, as time passed, different scientific workers experimenting with these rays found other wonderful uses aside from the medical ones. Lately they have been harnessed in modern industry, for the study of the properties of materials, says the *Edison Monthly*.

A very interesting experiment was made recently by one of the largest electrical companies in this country. A steel casting was received which was two and one-half inches thick, and which weighed about one ton. During the process of machining down to the desired thickness, slight imperfections were disclosed. It was then decided to make an X-Ray examination of the entire casting.

The steel was set on edge, backed by a sheet of lead, with a photographic plate between. A Coolidge X-Ray tube especially designed to carry high voltages was used. Current at 1.25 milli-amperes was passed through the tube with a two minutes' exposure. The resulting picture located a long flaw. To confirm the X-Ray diagnosis a disc was cut from the metal at a point indicated in Fig. 1, and the hole was found as shown.

In another test, copper castings were examined. Ordinarily copper castings are full of pores and blow holes, which not only reduce the mechanical value of the metal, but result in very low electrical conductivity. This, of course, is due to the oxidization of the metal when cast. Boron suboxide, a by-product of the manufacture of boron, has the property of deoxidizing copper without combining it, and is now generally used in all copper plants. In the test boronized coppers were examined side by side, the X-Ray photographs being recorded on the same plate. The pores in the unboronized metal showed clearly, while the treated metal showed a solid structure.

X-Rays are being extensively used by cigar manufacturers in killing the tobacco beetle larvae, a small insect living on the leaf of the tobacco plant, and if allowed to live it becomes developed, and eats its way through the finished cigar. These little insects are now being destroyed by exposing the finished cigars, which are packed in boxes, to the X-Rays, without affecting the quality of the tobacco.

These penetrative rays are also being used by naturalists in studying the structure of different vegetations and flowers, during development of the plants. Fig. 2 illustrates a flower radiographed; note the developed structure of the flower and the fine fibrous frame about the flower and leaves. Every vein of the leaf is clearly shown.

Various metals and precious stones are of late being studied with the aid of the X-Rays. These wonderful rays have, perhaps, performed more serviceable duty to mankind, than any other ray known, with, of course, the exception of our solar rays. Undoubtedly many more uses for the X-Ray will be discovered in the near future.

Fig. 2. This Flower Radiograph Was Made by Mr. W. H. Dodge of Chicago. Note How the X-Ray Has Brought Out the Fine Fibrous Frame about the Flower and Leaves.

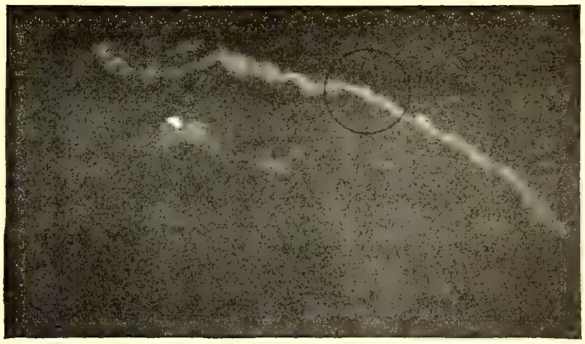


Fig. 1. An X-Ray Photograph of a One-Ton Steel Casting Disclosed the Serious Flaw or Hole Marked by the Circle.

CANADA TO EQUIP PARKS WITH RADIO SERVICE.

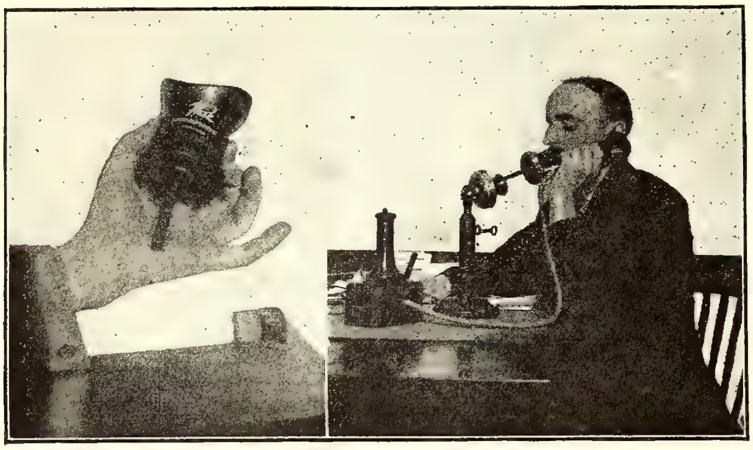
Philip E. Edelman, of St. Paul, Minn., has been engaged by the Canadian government as electrical engineer to prepare plans for wireless telephony and telegraphy installations to secure communications in the extensive Dominion Parks of Western Canada. The installation will be the first of its kind and a new application of radio-communication. The equipment will be of new design specially adapted for the difficult mountain service. The purpose of the installation is to prevent forest fires and game trespassing by affording a means for instantly reporting and calling for aid. The territory embraces some 7,000 square miles, where ordinary means are out of the question for purpose of communication.

USE OF ELECTRICITY IN PRODUCTION OF FLOUR.

The largest flour mill in the world, located at Minneapolis, is equipped with 5,580 horsepower in electric motors. This mill has in one day turned out 16,125 barrels of flour.

A Pocket Telephone Silencer At Last

Although the telephone of today is in a very high state of perfection, several little things are still to be improved, one of which is a device which will make the speaker's talk unheard by those around him, but making his speech audible at the other end of the line. Thus the talker's conversation will be transmitted to the party who is listening to him, yet people sitting close by will not hear what he has to say. This is very important in large offices where several people use one telephone but where no private telephone booths are used.



Showing Size of New Telephone Muffler and How It Is Used So as to Silence All Spoken Sounds. Has No Mechanical or Other Connection with the Telephone Instrument Proper.

Various types of telephone *silencers* have been developed by different inventors and the patent office records show that about eighteen of them have actually been patented. Many of these succeeded admirably in confining the speech, but failed in that they made the voice inaudible to the listener at the receiving end. Furthermore, as a rule the telephone companies will not permit any device, whether it is good or bad, to be attached to any part of their instruments.

For several years Maximilian Weil, a prominent electrical engineer in New York, has been devoting his time to perfecting a *telephone silencer*. The first silencer which he brought out had the same faults as those developed by previous inventors, and was impracticable for commercial work. He again set out to perfect his device and has finally solved the baffling problem. He has succeeded in bringing out an excellent telephone silencer, which apparently has overcome all the defects of other proposed types. It is clearly shown here, and is called the "Privaphone." The principle upon which it works cannot yet be disclosed, due to obvious patent reasons. But a representative of THE ELECTRICAL EXPERIMENTER has convinced himself that the instrument does actually accomplish the inventor's claims. The small tube shown projecting from the bottom of the instrument is placed near the transmitter mouthpiece and it was found that with this tube the efficiency of the working qualities is considerably increased. This tube is of a certain shape and size. If a different size tube is used the efficiency is at once lost.

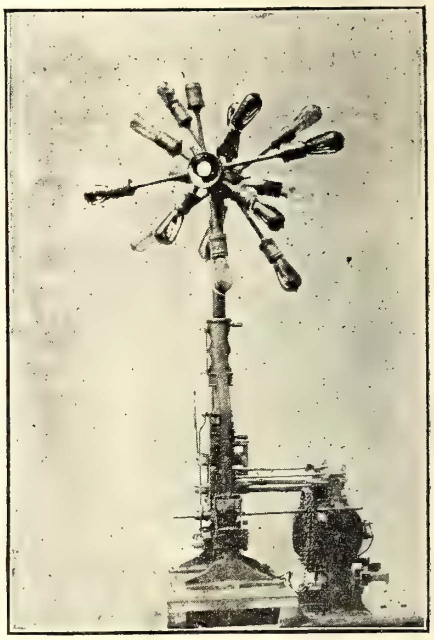
This silencer is quite small and can be carried in the pocket by anyone. For the office, however, Mr. Weil has developed an attachment to hold the silencer and receiver, thus leaving one hand free to write. The right hand view illustrates this arrangement. This photo shows the inventor using his silencer and the attachment.

The regular telephone receiver rests on a small box, or acoustic amplifier. The sound of the receiver is caught by this instrument, amplified, and sent through a rubber tube, which is connected to a special receiver. With this arrangement, the person using the new muffler has one hand free to write with. When the conversation is finished the regular telephone receiver is removed from the box and replaced on the hook. The two semi-circular rings on the amplifier cabinet are used to hold the silencer and attachment when not in use.

ROTATING LIGHTS GREAT WINDOW ATTRACTION.

A very unique and interesting electric window attraction has recently been shown in the New York City stores. It consists of two wheels revolving in opposite directions and having several spokes of different sizes, upon which various colored electric lamps are mounted. These wheels are revolved by means of an electric motor, mounted on the base. The power is transmitted by means of a belt and shaft, projecting inside of another shaft, which causes both wheels to revolve simultaneously. The outside shaft also is revolved by the same motor and is connected at the proper time by a friction clutch actuated by a special cam which is caused to revolve by the same motor. The power is transmitted by a sprocket and chain as shown in photograph.

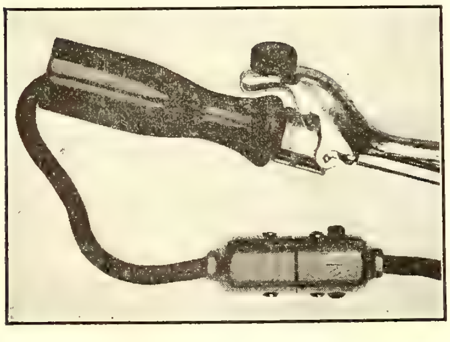
The operation of the device is extremely interesting and attractive. As soon as the lamps are lighted and the motor started the two light wheels begin to revolve very rapidly in opposite directions, which produces a rainbow effect. One of the cams then engages automatically the outer shaft which causes the wheels to revolve simultaneously, and at the same time they turn in opposite directions. The centrifugal force of both wheels causes some of the spokes to expand, which produces a wonderful intermeshing light effect. Although in reality the lights do not cross each other, yet when traveling in this way the eye cannot catch quickly the inter-lapping, resulting in a kind of optical illusion, which renders this effect so unusual. When this movement is over the inner shaft is disengaged by a cam and the two wheels are caused to revolve laterally without having each of the wheels turn in opposite directions. This also creates a curious effect. The last movement is perhaps the most interesting of all. By a special arrangement of the cams and clutches the wheels are caused to revolve in such a manner that one seems to turn half way and then come back again. Both wheels perform the same function but in opposite directions, and finally both assume a rapid whirling motion, caused by the interlocking of the outer shaft. The movements are then again repeated. This unusual yet simple machine has been developed and patents applied for by Charles Tregoning, a New York engineer.



By Simply Rotating the Two Rings of Lighted Lamp Bulbs in Opposite Directions, Wonderful Effects Are Produced on This Apparatus.

NEW NON-TWIST SWIVEL CONNECTOR.

A new form of swivel connector, intended to prevent the twisting and knotting of flexible cords, has recently been patented. This swivel is not separable as a connector. In general the operation devolves upon a central rod, which acts as one conductor, and one or two concentric ball bearing rings which form the other conductor. There are a number of special applications for this swivel. In the illustration it is equipped with a snap switch, and is used with an electric curling iron. Other special types are supplied for electric irons, attachment plugs and telephone cords. Since the cord contains three wires, two concentric rings and the center-rod are used as connectors. Manufacturers have already taken up this device for use with various electric attachments and apparatus. It has been approved by the fire underwriters and therefore will undoubtedly find a wide field of application.



An Ideal Swivel Connector Which Eliminates Twisted Cords and Short-Circuits. Ball Bearings Cause It to Turn Easily at All Times.

NEW TUNGSTEN DEPOSITS.

"It's an ill slide that slips nobody a piece of luck." News reports state that a Western mountain avalanche has uncovered tungsten deposits assaying eighty-five per cent., a mere matter of $8,000 a ton at present prices for the commodity.

Over 2,000 miles of the railroad lines of this country are now operated by electricity. In recent tests between steam and electric traction with the same load of freight up a 2 per cent. grade, the electric locomotive had an average speed of 15 miles per hour as against 7 miles for the steam engine.

THIS ELECTRIC "KNIGHT" A REAL GIANT.

By Charles Alma Byers.

The photograph reproduced here shows the huge electric-sign decoration which

An Electric "Knight" Standing 60 Feet High with His Charger. A Beautifully Illuminated Figure with Lamps of Various Colors.

graced the front of a department store in Los Angeles, Cal., during the Knight Templars convention held in that city in June. The sign represents a mounted *knight* and is about 60 feet in height, or equal to the height of five stories of the eight-story building, reaching from the top of the second story to the bottom of the eighth. The horse is shown in amber, the man in white, and the cross of the shield and a part of the banner in red. The picture shows the sign as it appeared at night, illuminated.

FEAR OF LIGHTNING.

During a severe thunderstorm at Newton, N.J., a woman who "through all her life of fifty years had felt a nervous dread of lightning" became unconscious from fright and died.

Cannot the multitudes of otherwise rational people who are obsessed by the same dread take counsel of the fate of this unfortunate and allay their fears? says the editor of the New York *World.* They actually suffer through a reign of terror in every thunderstorm and in effect undergo the agony of death many times. Yet there are few other forms of death so painless or so remote. In 1912 in the whole country only 243 persons were killed by lightning, of whom but thirty-two were females. Women who mainly feel this fear should be encouraged by their greater immunity.

But in fact a far greater number of people are burned to death in conflagrations in a year than are killed by thunderbolts, and the number of those who die from organic heart disease compared with those who die from lightning is as 354 to 1.

People who view their inescapable exit from this world with philosophy should be ready to accept a lightning stroke as an end as easy as any other. It is too instantaneous to admit of physical sensation; while the fear-ridden are assured that if the flash is seen the sufferer is safe for the time being.

NEW STORAGE BATTERY ROLLING CHAIR.

The motor chair here portrayed consists of a motor, controller and storage battery mounted on substantial running gear with ball bearings and rubber tires. These are so skilfully correlated as to form a perfect running, self-propelled vehicle under absolute and easy control. It can be adjusted to any speed from one to ten miles per hour. When going down hill, the rated speed is not exceeded more than from ten to fifteen per cent.

It has one very important feature, secured by patents, which shuts off the current and sets the brakes when the chair comes in contact with any obstacle. This feature eliminates much of the danger of operation.

The control of the chair is very simple and practically fool-proof. There is only one foot pedal used, by which the starting, stopping and braking are all done. To start the chair, the rider pushes the pedal and the chair starts. To stop, he pushes the pedal forward until it locks and the chair is stopped with the brake set tight. The prevention of excess of speed down hill is effected automatically by an electrical method. It can be fitted with a hand control if desired.

The chair is guided and steered like an electric automobile with a steering handle requiring just the pressure or weight of

Now We May Glide Along the Board-Walk in Our Electric Rolling Chair.

the hand to guide it, and the tendency of the car is to run straight ahead on releasing the handle.

The chairs, fully equipped, weigh 400 pounds and will make the ordinary grades in parks and boulevards. The batteries are of the ordinary type and can be charged at any garage or at home.

These chairs combine all the advantages of ease in handling, cheapness in operation, exceptional safety and adequate speed. They provide means of pleasant and comfortable locomotion at seaside resorts, hotels, etc., and proved a big attraction at the 'Frisco exposition.

We strongly recommend all those interested in thunderstorm phenomena, the reason for lightning flashes, their nature and especially as to how to protect one's life, to read an extensive article entitled *"Lightning, Its Effects and How to Avoid Them,"* which appeared in the April, 1916, Electrical Experimenter.

"HELLO HAWAII, HOW ARE YOU?" LATEST IN RADIO MUSIC.

Oh, yes, it simply had to come! The song writers have now turned their energies toward the long distance radio telephone, with the result that "Captain Jinks one night on Broadway, all alone—read the news about the wireless telephone. Pretty soon his thoughts began to stray. Over seven thousand miles away," etc., so we learn. He sure was some old gad-about, was "Captain Jinks." What? Well, anyway he had a perfect right to let his mind wander Honoluluward and so have you, gentle reader, if your "roll" will stand the tune of about 500 cold simoleons per "talking minute."

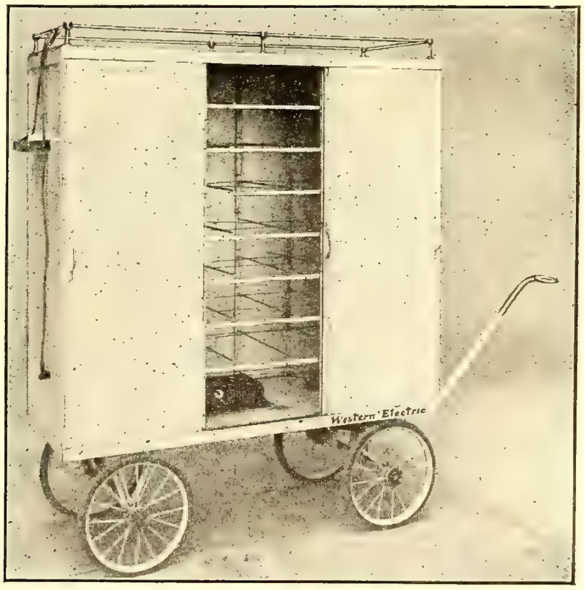
Aside from this the tune is catchy and is now heard up and down Broadway and in and out of the cabarets.

HOSPITAL FINDS NOVEL USE FOR THE ELECTRIC AIR HEATER.

The St. Mark's Hospital of Salt Lake City, Utah, has a set of four dumb waiters running from the basement to the first, second and third floors carrying food from the kitchen to the various wards. Great difficulty was encountered at first in keeping the food warm from the time it left the kitchen until it arrived at its destination.

Mr. Chadron, General Manager of the hospital, gave the problem careful study and finally designed and had built seven portable wagons. These wagons accommodate 26 trays and are arranged with sliding doors that make them practically air tight. A Navy Type air heater is mounted on the bottom of the wagon with a cord and plug attachment capable of being connected ten feet away from the wagon. An hour before each meal the heaters are connected to a source of electric current so that at meal time the interiors of the wagon are satisfactorily heated. After the wagons are loaded with the trays of food, the heaters are disconnected and the whole contrivance is placed on the elevator and raised to its destination where the heater is again connected to a source of current supply and remains so until the last tray is removed.

The new system is in constant operation and it is found to work perfectly—the food is served to the patients quite as warm and palatable as when it left the kitchen range. Photo courtesy *Western Electric Co.*



Novel Electric Heater on Wheels Used for Carrying Meals in a Hospital.

Electrotypes and Their Making

The general reader has possibly never stopped to realize the large amount of work that must be gone through to make an electrotype. This article has been prepared for the general layman, who has been mystified as to the process of making electrotypes, which is perhaps one of the most important features in the printing of a modern journal such as this one.

The Wax Impression Used as a Base in Making Electrotypes. Covered with Plumbago and Immersed in an Electroplating Bath, It Becomes an Easy Matter to Form a Copper Fac-simile.

The first step taken for making an electrotype from an ordinary photograph or line drawing is to re-photograph the picture through a finely engraved glass screen and then photograph it on copper or zinc; if a "half-tone" or engraving from a photograph is desired, copper is invariably employed. It should be understood that the metals are at first coated with some light sensitive emulsion, such as silver iodide. After the plate has been exposed, it is developed and fixed in the usual method; then it is coated with dragon's blood and baked in a furnace. After baking, the cut is placed in an etching bath containing concentrated nitric acid, which eats away all the copper which was not coated with the dragon's blood. Finally the plate is washed and fastened to a block which then completes the halftone cut. The electrical process is used whenever duplicates of these half-tones or line cuts are needed. These duplicates are termed *electrotypes.*

The entire page on which this article is printed, as well as all the other pages, are electrotypes. As it is not advisable to print directly from type and from the original engravings and line cuts—for they would wear out rapidly on a long printing job such as this journal calls for—the entire page is electrotyped. First the reading matter is set up on the linotype, then the illustrations are placed in their proper positions. A proof is pulled and sent to the editors. Corrections are then made and a "final" proof submitted in due course. After the Editor-in-Chief has o.k.'d this proof, the entire page is locked up in a printing "chase" and sent to the electrotyper, who makes one solid electro of the entire contents of the page. text as well as illustrations. Thus, instead of handling a lot of type metal and separate illustrations on the press, only one solid piece of metal—the electrotyped page—is used.

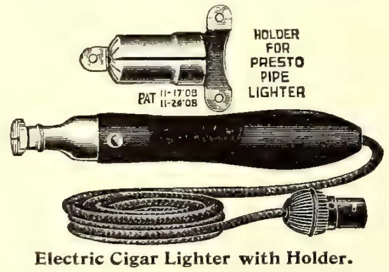
To make an electrotype the original half tone is forced into a beeswax compound by a special press. This compound consists of a mixture of zokorite, a by-product of the distillation of petroleum, mixed with one-third its weight of ordinary beeswax. To this mixture a certain quantity of powdered plumbago (graphite) is added to make the compound more slippery, as it is technically called. It is used for making the wax more adhesive so that when the original cut is removed, no portion of the wax will stick, as it would tend to show in the finished electrotype. The wax impression is then removed and treated with a fine powder of plumbago. This is lightly sprinkled over the wax surface to make the wax a conductor of electricity. The mould is now trimmed around its edges with a curve-shaped knife in order to remove all parts that are not wanted in the finished electro. The wax cast is next placed in a machine brush which polishes up the surface of the wax with finely powdered plumbago. Then after receiving the proper finish, it is thoroughly rinsed with water and coated with a fine layer of iron filings, making it a still better conductor to the electric current. The iron-coated form is now washed with a copper sulphate solution (blue vitriol), which precipitates a thin film of copper over the entire waxed surface. This is the last process of making the wax conductive. Finally it is placed in a copper plating bath and connected to the cathode, or negative terminal of the electric dynamo, while the anode, or positive electrode, consists of a pure copper plate, which is linked to the positive side of the electric generating machine.

The solution of the plating bath consists of copper sulphate crystals, dissolved in water. In this way the mould receives an even coat of metallic copper, due to the transmission of copper from the plate to the surface of the metalized-wax mould by the current.

After a firm coating of copper has been deposited upon the cast, the electric current is shut off, the mould removed and then thoroughly washed with clean water. The fine film of copper representing the impression of the original half-tone or line cut of the mould is now carefully removed from the wax. The raised portion of the copper film is used for printing while the impressed portion is filled with molten type-metal to strengthen the completed electrotype. When the molten metal has cooled, the electrotype is trimmed with a metal saw and nailed on a wooden block of standard thickness. The surface of the cut is then carefully gone over by an engraver to strengthen the important lines. This is the last step taken in the making of an electrotype. It is then ready for the printer.

NOVEL ELECTRIC PIPE AND CIGAR LIGHTER.

A new electric cigar and pipe lighter, designed especially for automobile use, is now being manufactured. The ten foot connecting cord is wound up by a spool, so that it can be kept under the seat or behind the dash board when not in use. A

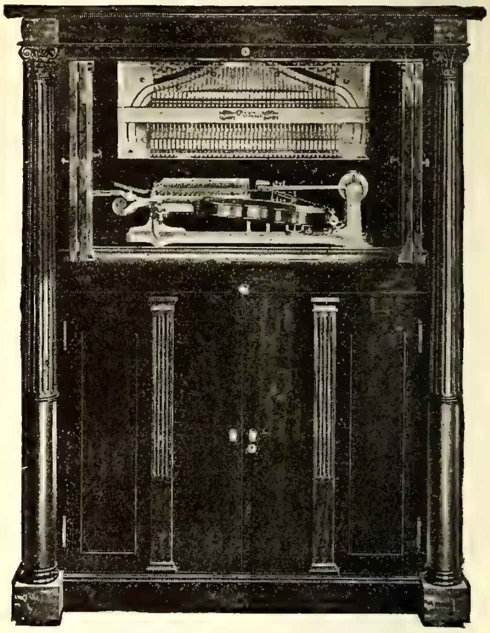


Electric Cigar Lighter with Holder.

spring tension actuates the spool. When the switch is closed a grid at the end of the handle becomes incandescent. Since this is not affected by the wind, a pipe or cigar can always be lighted from it.

AN ELECTRIC VIOLIN AND PIANO.

Most people realize that the violin is perhaps the sweetest musical instrument in existence, if a skilled player uses it, but today very few violinists exist who can handle the instrument with sufficient technique to produce the supremely sweet tones of which the instrument is capable. Of late, scientists and musicians have labored on an automatic musical instrument which would reproduce the tunes just as well as the best player and the result of their efforts is illustrated in the photograph.



Both Violin and Piano Music Are Produced by This Electrically Operated Device.

The violin rests horizontally in the upper corner of the cabinet, while back of the violin are the various wires of the piano. The fingering is done by means of sixty-four individually controlled electro-magnets, which actuate the fingers. The bowing is done in a similar manner—the different strings having separate bows which consist of circular disks of special grade leather. These are automatically controlled both in speed and pressure by electro-magnets. The proper amount of rosin for the strings is also automatically applied.

The strings and bows are manipulated by a perforated roll, each perforation corresponding to a certain distinct note. When the instrument is in operation the roll is drawn smoothly between rows of metallic points or brushes. At the very instant when the points of one brush touch those of the other through these perforations, an electric current is sent through the particular electro-magnet which actuates the finger and bow. The perforations on one side of the roll control the playing of the violin; those on the opposite side control the playing of the piano.

This piano control is somewhat like that of a compressed-air player piano in which a perforated roll is drawn across a metal bar, containing apertures through which air is drawn. The ordinary player piano is operated by the pumping of bellows and is governed by the hand movement of levers, but in this new type, the piano-string hammers are actuated by electro-magnets controlled by the perforations of the paper roll.

This is another achievement in automatic electric musical instruments for those who cannot play themselves.

The Unterrified Amateur

By Thomas Reed

36533

AN amateur wrote to the Question Box last fall some time: "Please tell me how to make an Audion bulb." Simply and casually, like that—just as Mrs. Smithers would run over and ask your mother for her receipt for raised doughnuts.

He was a regular fellow, that "bug," and I liked him. An Audion bulb! You bet there was no such fool word as "impossible" in his bright lexicon.

Now the Question Box editor is a humane man and wouldn't hurt an amateur if he could possibly help it; they say he wouldn't even run over one with his Ford car (provided he owned one), he is *so* particular. But when he saw that question he recognized that it was up to him to be "cruel only to be kind." Reflecting upon the variety of malicious tricks that glass can play, he sought to shield the rash "bug" from an attack of bitter disappointment. So he swallowed a mugful of liquid concrete, to harden his heart, and phoned the printer to set up in cold type the fatal answer: "Unless you have the equipment and skill for glass-blowing, it can't be done."

Well, do you think that "bug" gave up his project? Not a bit of it. I don't know him from Adam, but I know he didn't. No mere Question Box answer would convince him that he couldn't make an Audion. He just thought the editor was mean, or lazy, or something, and wouldn't tell him; so, without any further worry, he dug into the encyclopedia, read up on glass-blowing, and went at his Audion, editor or no editor.

He couldn't make the thing, I'll lay dollars to doughnuts on that; but he knows a lot about glass now that he didn't before. No knowledge, once acquired, is useless. If he ever gets so he can make glassware, he can turn that knowledge into a real nice simile for certain women; he can say they are like glass, because they are innocent and self-effacing, apparently, but full of the most diabolical obstinacy the minute you try to do anything with them. (Cheese-it, madam, drop that stove-lifter; I only said "certain" women, didn't I? I didn't mean you at all.)

The reason I know so much about this amateur is because, years ago, I tackled a similar impossibility, an X-ray bulb. From an unbroken series of victories in science, our crowd had come to consider that they had the world pretty well by the tail. (The really hard things of life, such as selling a bill of goods, were as yet mercifully hidden from us.)

About that time Mr. Röntgen showed up with his X-ray apparatus, and the population went daffy over the ability to see the inside of a foot, or a pocket-book, or any old thing they had no business to see inside of.

I remember the first thing mother thought of was that Mrs. Skillings, next door, might get one of the things, and train it on our house, and see how awfully untidy the attic looked. To be on the safe side, mother went and cleaned up the attic, though it was right in the middle of the hot weather. When she got through, she was tired, and sort of mad, and said she wished people would stop inventing things.

Our crowd decided very soon to make a Crookes tube, and test out this X-ray thing. Of course we were not prompted by any petty curiosity, such as mother charged on Mrs. Skillings. Men have no curiosity; what they have is *scientific interest.* Science, however, may make use of human frailties to further worthy causes; so I approached mother for a small investment in the enterprise on the prospect that she might look into Mrs. Skillings's attic. But mother said she didn't need to; anybody who kept her front steps looking the way Mrs. Skillings did had a dirty attic as a matter of course. So we had to finance the proposition ourselves, as usual.

As I remember it, our combined stock of knowledge regarding the art of glass-blowing consisted of the fact that it required heat. We bought a length of glass tubing and engaged in a series of preliminary experiments over the fishtail burner in the bathroom. By the time the first length was used up we knew quite a few additional things about glass; for instance, that it cracked readily; that bending a tube had quite a tendency to close up the hole—it was not elastic, like macaroni, but on the contrary flabby, like a promise to pay back two dollars. Bulbs blown out on it were inclined to be warty and small, rather than symmetrical and large, and if urged too far, they punctured with a noise that sounded like "Flap!" And first, last, and especially, we learned that the physical effect of prolonged blowing was an interesting symptom resembling the more finished stages of acute apoplexy.

These facts, useful as they were, did not advance us far toward the X-ray. Instead, they led us back a step; for we had to build a blowpipe, which we could use in our accustomed haunt. We were also influenced by a certain restiveness which had developed in the family, due to our continuous occupation of the bathroom.

The blowpipe worked beautifully. It had a nice foot-bellows and produced an invisible flame that our fingers had a perverse way of getting into. We bought another yard of tubing and began to blow shapes. They were interesting shapes, some of them; but, as they seemed to be the result more of accident than design, the doctrine of probabilities was dead against our happening to hit one that would do for a Crookes tube—that is, within a reasonable time, like a century.

". . . . We hitched on our poor, mis-shapen Crooke's bulb and began pouring that mercury. You put it in at the top, I recall, and it gurgled down through the thing till it came out at the bottom and you caught it and started it all over again. Its gurgling was supposed to gurgle the air out, but somehow it didn't."

We recognized this; and, looking about us, as amateurs do, for articles in the domestic world that can be adapted to the purposes of science, we discovered a plentiful supply of just-what-we-wanted in electric-light bulbs. Owing to unavoidable casualties, we required a good many. We used up all the burned-out ones in the box and then levied cautiously on the active sockets. It was a close call; but just as we were about to encroach on the lamps the family would miss the quickest, we achieved a success, producing a bulb with all three tubes stuck on, good and tight, though somewhat blobbily.

The cheering over this accomplishment had hardly died away, however, when someone noticed that we had forgotten to put in the cathode. You know how it feels when your trunk is all strapped and the expressman is stomping up the front stairs after it, to find your best suit left out on the bureau? It is something like that, when you find a half-inch disc lying around that

(*Continued on page 372*)

The Electrical Mechanism of the Ether

By A. Press, B.Sc.

THE electrical theory of Maxwell was based on the assumption that when a body was electrified something in the nature of a displacement passed from the body into the ether, and from the ether to some other material object or objects said to be thereby oppositely electrified.

That the displacement was not material, that is, it had no weight, went without saying, for with the most delicate chemical balance no difference in weight could be detected. It, therefore, had to partake of an ether-like displacement because the ether is supposed to have no weight.

Maxwell conceived the idea that it was this mysterious displacement, by an unrevealed physicial mechanism, that caused electrified bodies to be attracted or repelled according to the well-known material Newtonian laws of mechanics.

Whereas, the electrical displacement itself is intangible as it were, because it involves the ether only, forces always very visibly manifested at the material bounding surfaces of the ether were conceived to take place by virtue of a special displacement mechanism which Maxwell assumed. This displacement mechanism was considered to be located in the ether itself rather than in the electrified material bodies.

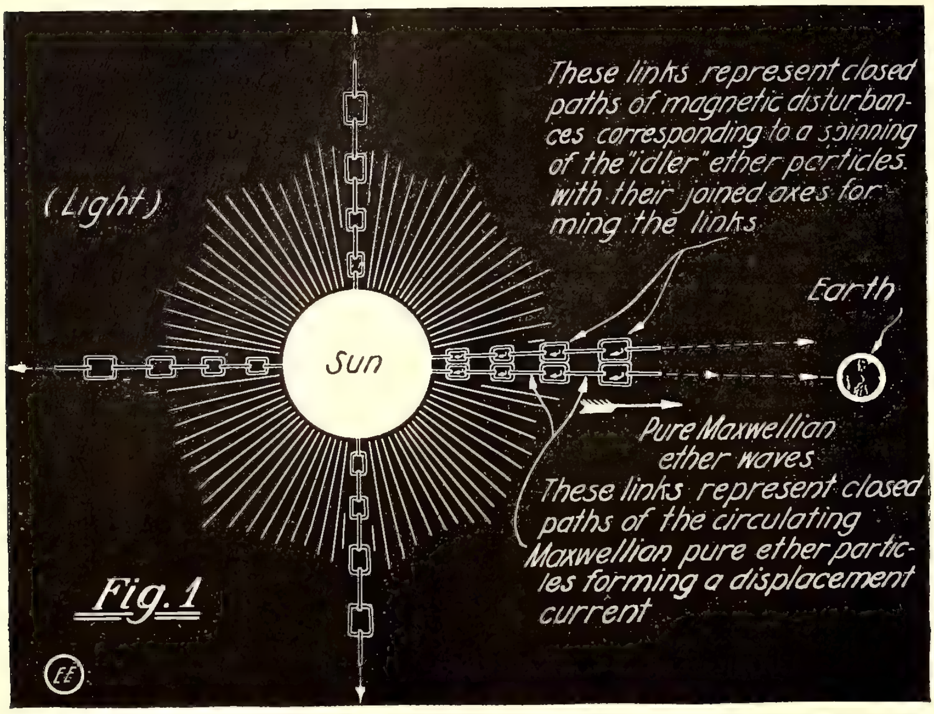
Forces there must be in the ether, but it is necessary to remember that we can make sure of their existence only by mechanical reactions of the ether upon material bodies. When the forces wholly refer to the ether they are designated as "generalized" forces. Thus, although an electro-motive force is regarded as setting up a flux of electric displacement this *force* cannot be considered a true force in the Newtonian sense, for matter is not involved, except indirectly. The mechanical or Newtonian forces that are observable on electrified bodies always imply matter. Electrical instruments are employed it is true *to measure* E. M. F.'s (potentials) and currents, but it is very obvious that what we are really measuring are the reactions of the ether upon material bodies and not the *forces* that act wholly and entirely on the parts of the ether medium itself.

The question can arise whether electricity as such can exist apart from matter. Heaviside is decidedly of the opinion that it cannot. We know that like charges repel each other and therefore the functions of material bounding surfaces for the ether appears to be to keep the like elemental charges together. Just how this property is maintained is at once one of the mysteries and distinguishable properties of matter.

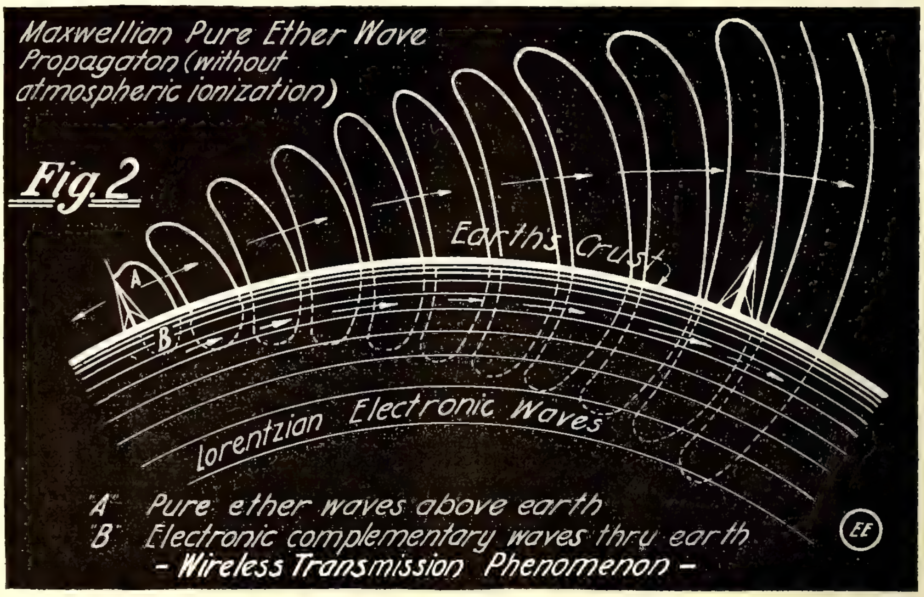
In the newer theory of Lorentz, electrification or displacement is said to be due to *electrons*. In the first place it is difficult to see how any portion of electricity can manifest itself except by a material reaction which can account for a Newtonian force being set up, yet single negative electrons have been observed. Again, if the electron or *atom of electricity* were of the imponderable ether substance then there is difficulty in accounting for the elemental electric charge keeping itself intact; for even an electron is supposed to have dimensions. It was from this latter sort of consideration that Heaviside foretold that the observable electron would be found to have a *material nucleus*. It would also seem to nullify the earlier electric particle hypothesis of Maxwell.

Strange to say in attempting to form a physical picture of electrical displacement, Maxwell himself imagined a sort of purely ether particle which bears a very close resemblance to Lorentz's electron particle. However, such makeshift devices, for such they are, do not by any means enable us to explain how mechanical energy can be converted into electrical energy or how electrical energy, such as the electro-magnetic light waves from the sun, can be transmitted through space to be thereafter transformed into work in the service of man, or how even to interpret matter in terms of the ether.

Both Lorentz and Maxwell imagined their ultimate electrical particles to be of such a nature that, in what are called dielectrics or insulators,the electrons are only capable of moving a very short distance from their normal state of equilibrium; whereas in conductors, such as copper, the electrons were considered to be free and capable of being set in motion by appropriate etherial or as we would now express it—electromotive forces. Such *forces,* as has already been indicated above, are not to be confounded with the mechanical forces such as pressure or inertia. Yet when a conductor passes through a state of the ether called a magnetic field, the electrons in the conductor are assumed to be impelled in a certain direction. So far as the electrons are concerned, it is an electro-motive force that causes the electrons to travel through what are really the large-sized pores of the metal; but so far as the copper or material conductor is concerned it is a Newtonian mechanical force or pull that will be found necessary to be applied to set up the electronic displacement.



A Schematic Representation Showing How the Pure Maxwellian Ether Waves Pass Thru Interstellar Space from the Sun to the Earth with Velocity of Radiant Light or 186,000 Miles per Second.

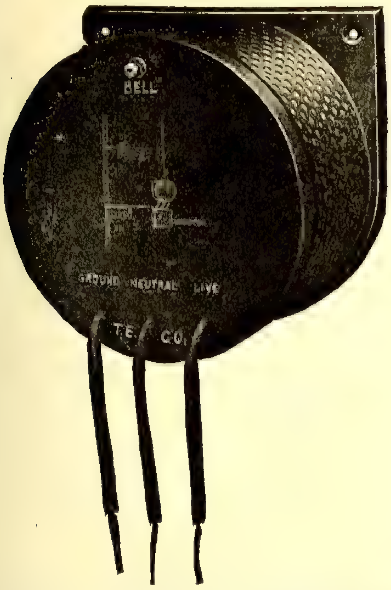


The Complex Action Occurring When a Wireless Wave Speeds "Over" the Earth and "Thru" It, by Virtue of Pure Ether Waves (Above) and Electronic Propagation Below the Earth's Surface.

(*Continued on page 374*)

RESISTOR TYPE D.C. BELL RINGER.

This bell-ringer differs from the usual type in that it reduces direct current by resistance. The low-pressure current varies from 6 to 35 volts. In one type there is a constant current consumption of 0.6 ampere. Another type, however, consumes



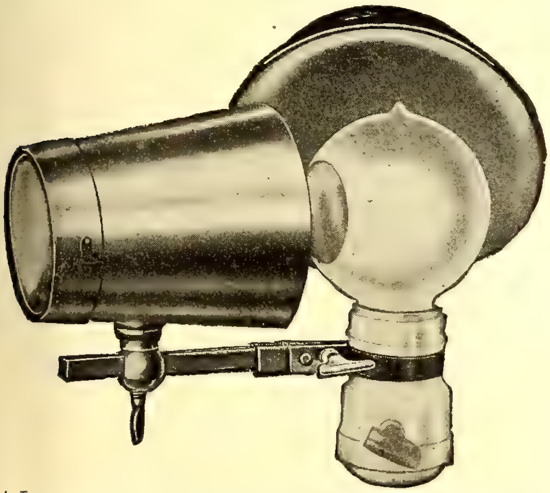
Bell Ringer for Direct-Current Circuits Working on the Resistance Principle.

only 30 milli-amperes ordinarily, but when the bell circuit is closed a relay connects a low resistance coil on the primary side. The current flowing is then 1.5 amperes. Different sizes of these instruments consume from 5 to 200 watts, for running interior telephones, electric clocks, time stamps, thermostats, ignition coils, cauterizers, miniature lamps and toys. It fulfils the function on D.C. circuits of the transformer used on A.C. circuits.

NEW INCANDESCENT LAMP CONDENSER.

An improved incandescent lamp concentrating lens is shown in the accompanying illustration. This condenser is a great advantage to dentists and other artisans requiring a concentrated form of light.

It projects an intense white light in an approximately parallel beam, without shadows or reflections of the filament within



A Powerful Condenser for Use with Incandescent Lamp and Capable of Projecting an Intense Parallel Beam of Light.

focal distance. The clamping device supplied with the condenser permits it to be attached to any standard lamp socket.

The lens can be easily cleaned and replaced by removing the caps on the condenser barrel. To exclude light the separate shield may be attached to any part of the rim. The condenser lens barrel may be moved along the horizontal bar secured to the socket as perceived, and then clamped in the desired position.

AN ELECTRIC HOT-AIR TOWEL.

A very unique hot-air towel nicknamed "The Notowl" has been recently brought out. By pressing down a foot lever located at the base, air is drawn into an air shaft by a suction fan and is passed through a heating element, comprised of coils of high resistance, connected to the current mains. The heated air is then forced out through a small pipe opening at the front of the machine.

This sanitary appliance takes about twenty to thirty seconds to dry the hands, a process to be accompanied by vigorous rubbing. The sanitary advantage of this device over the towel is apparent to all familiar with big building equipments. Moreover, it is so constructed that no amount of investigation on the part of public meddlers can put it out of operation.

Another advantage of the hot air towel is that its cost for upkeep compared to towels is only one-fourth as much. Of course this figure is obtained from an office which is employing a large number of towels.

The mirror in front of the machine should greatly appeal to all female users.

The "Notowl" Comprises an Electrically Driven Heater and Blower Controlled at the Touch of the Foot.

REPORT OF APRIL MEETING OF THE INVENTORS' LEAGUE OF THE U. S.

President Whigelt called the meeting to order. The minutes of previous meeting were read and approved. Mr. G. W. Speirs, in the absence of Mr. Lackner (excused), acted as secretary pro-tem.

Communications were read and placed on file as follows, viz.: From Mr. H. D. Sears, our League's attorney, who is at present in the southwest. From the chairman of the patent law committee of the House of Representatives, regarding some amendments against which the League protested. From Mr. Charles P. Steinmetz accepting his election as Honorary Member.

The resignation of Mr. Charles C. Gladwin was unanimously accepted.

At the request of Mr. Haggerty, Mr. Fowler explained the relationship between employer and employee, in regard to "Who should be entitled to full ownership of an invention or original idea produced during the time of employment." This created considerable interest.

President Whigelt explained a few items in connection with the suggestions made by the attorney-members regarding the enactment of new patent law amendments, several of which were of considerable viciousness and against the interest of investors.

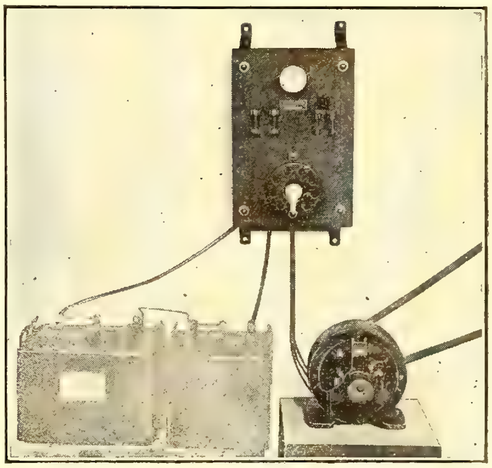
Mr. Waring demonstrated the many advantageous uses and features of his newly improved baseball mit.

Mr. Haggerty placed in nomination as honorary member, Mr. Henry Ford, who was unanimously elected as such. Mr. Ford's interest in the League was shown by the previous visit of his personal representative.

The upholding of our high standard of membership was discussed by a number of those present and an increase in membership is anticipated. Mr. Kampel was appointed by the President as a member of the House Committee in place of Mr. Charles C. Gladwin, resigned.

NEW BATTERY CHARGING EQUIPMENT.

A number of charging panels have been brought out during the past few years. Each type seems to outdo the last, either in efficiency, simplicity or low price. The set illustrated here is one of the most economical for a garage equipped with motive power. The dynamo generates sufficient current to charge one to five six-volt batteries up to two, twelve-volt cells. Any voltage, from 2 to 30, can be used. The outfit is supplied complete with a switchboard mounting a two-way ammeter, rheostat, main line switch and fuses, two connecting leads, 40 volt generator,



A New Simplified Storage Battery Charging Outfit for Autoists.

blue-prints and instructions. These sets are widely employed now that electric lights are used on autos.

Engineering As a Vocation. An Article for Students and Parents

By H. Winfield Secor, Assoc. A. I. E. E.

ARE you contemplating taking up a course in engineering? If not you may possibly be otherwise responsible as the guardian of a young man who thinks he will like engineering as a life work. Read this article before deciding on a vocation which, among other things, requires an aptitude and affinity for abstract philosophical thought. To be a successful engineer one should have a real liking for mathematics and the problems occurring in everyday work which require an exact analytical treatment for their solution. Engineering to-day has indeed become a broad subject, embracing not only technical studies but business problems as well in many, if not a majority of instances. The business man who is first an engineer is the more likely to succeed in a great number of cases, particularly where intricate scientific details are involved in the manufacture of his goods.

NOW that the college and high school sessions will soon begin their activities anew and as hundreds and even thousands of young men will, in the nature of things, be obliged to select their life work, it behooves every one, whether choosing for himself or for his children, to spend a more than passing thought on the subject.

This article will deal particularly with some of the advantages and requirements necessary in the engineering profession, particularly the electrical branch.

In the past few years there has been a great impetus given to engineering in general, and to-day we have with us a greatly diversified ramification of engineering branches, and sub-divisions. No longer can we speak of this term in a general sense so as to infer any definite scope of activity, as this line of human endeavor has become very highly specialized in the last few years. There are, for instance, electrical and mechanical engineers, civil engineers, mining engineers, telegraph and telephone engineers, radio engineers, chemical engineers etc., *ad infinitum.*

It is really surprising to look over some of the catalogues and literature put out by our engineering schools of all classes, including correspondence institutions, to note the many new branches of applied science which have become sufficiently important to warrant the offering of a course of study in that line only. To begin with, not every man (or woman for that matter, as we do really have some female engineers and architects with us now) is adapted physically and mentally for the vocation of engineering, speaking generally. In a preliminary investigation recently made by the Carnegie Foundation for the Advancement of Teaching in New York City, there were found to be six desirable groups of factors which are essential to the successful engineer, as follows:

1—Character, covering integrity, responsibility, resourcefulness and initiative; 2—Judgment, covering common sense, scientific attitude and perspective; 3—Efficiency, covering thoroughness, accuracy and industry; 4—Understanding of men, including executive ability; 5—Knowledge of the fundamentals of engineering science, and 6—Technique of practice and of business.

Mathematics is, in most every case, the real basis of the engineer's education, no matter whether it be civil, electrical, mechanical, or radio. Moreover, it is desirable for the technically trained individual to be well versed in mathematics for a number of highly important reasons. Several of these have been recently mentioned by Dr. Robert E. Moritz, professor of mathematics at the University of Washington. He states, among other things, that, contrary to the obsolete and popular idea that higher mathematics are nothing but a waste of time for the average student; these studies, and only these, can develop the following powers of the human mind:

1st. The power of undivided attention and prolonged concentration. 2d. The power of exact definition, of clear statement and of a critical and concise analysis. 3d. Power of deductive reasoning, of drawing logical conclusions from given premises.

One of the first things which should be done by prospective engineering students and parents intending to send their children to colleges or other academical institutions, is to obtain catalogues from the leading schools teaching various technical subjects. A number of worthy technical schools advertise in this journal and information concerning colleges and schools featuring engineering subjects will be given if those interested will address the author in care of this magazine, enclosing stamped envelope for reply. From this literature a great deal of information can be obtained, and whenever possible it is preferable to have a conference with an engineer who has been in the business for a number of years and who can explain the many prac-

The outline of studies for a general electrical engineering course given below will provide a nucleus upon which to build a good idea of the knowledge required of the graduate on this subject. About three years' continuous or four years' (with summer vacations) time is necessary to complete such a course usually.

Arithmetic	System
Elements of Algebra	Alternating Currents
Logarithms	Alternators
Geometry and Trigonometry	Alternating-Current Apparatus
Graphs Calculus	Design of Alternating-Current Apparatus
Geometrical Drawing	Electric Transmission
Mechanical Drawing	Line Construction
Sketching	Switchboards and Switchboard Appliances
Practical Projection	Power Transformation and Measurement
Development of Surfaces	Efficiency Tests
Principles of Mechanics	Mercury-Vapor Converters
Machine Elements	Storage Batteries
Mechanics of Fluids	Incandescent Lighting
Strength of Materials	Arc Lighting
Heat and Steam	Voltage Regulation
The Steam Engine	Modern Electric-Lighting Devices
The Indicator	Electric Signs
Engine Testing	Electric Heating
Governors	Interior Wiring
Valve Gears	Electric-Power Stations
Steam Turbines	Telegraph Systems
Electricity and Magnetism	Telephone Systems
Electrodynamics	Radio Telegraphy
Electrical Resistance and Capacity	Radio Telephony
The Magnetic Circuit	Applied Electricity
Electromagnetic Induction	Electric-Railway Systems
Chemistry and Electrochemistry	Line and Track
Primary Batteries	Line Calculations
Electrical Measurements	Motors and Controllers
Dynamos and Dynamo Design	Electric-Car Equipment
Single-Phase Railway	Multiple-Unit Systems
	Direct-Current Motors

tical as well as business features of the profession, topics which are either ignored altogether in the average college prospectus or else much overdrawn as in some of the brochures put out by some of the second rate schools. The fact of the matter is, that between these two there is a happy medium which the student must decide.

It goes without saying that unless one is of a studious disposition, and particularly along the lines of philosophy and mathematics, it is very doubtful whether they should seriously undertake an engineering course, with the object of a life vocation as the goal. The course of study in any first-class school or university is rigid, as it should be, yet comprises a sufficiently broad outline of topics to give a well-rounded education. The electrical engineering subjects include mathematics, mechanical drawing, physics, steam engines, various types of dynamos and their design, alternating and direct current systems, electric railway work, illumination, testing of machinery, both electrical and mechanical for efficiency and performance characteristics, electric motors and their industrial application, chemistry, besides studies in technical French and German.

The curriculum of some schools includes, among other studies, additional languages such as Italian or Spanish. A knowledge of these languages is of paramount importance, and is one, perhaps, which every engineering student, at the start, will certainly balk at. He will not be able to see just why he should be required to study these "dead" subjects, as he feels sure he will never have to go abroad to install an electric generating plant or telephone exchange. This has really nothing to do with the reason as to why these languages should not be mastered, at least in their technical phase. The unequivocal necessity for these studies lies in the fact that some of the best literature available on all branches of technology and engineering, exist in foreign books and periodicals.

It is true that there now exists a goodly number of excellent books in the English language on all ordinary technical subjects. However, there are a number of valuable periodicals published in various old world countries, which, from time to time, contain extremely important articles by leading authorities and scientists. These the American engineer would probably never be aware of if he cannot read these publications, unless it be in some poignantly brief excerpt published in America a year or so after the original publication of the foreign paper. Particularly does this hold true for German, French and Italian periodicals.

Not every aspirant to engineering laurels has the means or wherewithal to attend a first-class college or university in the pursuance of his studies. There are several other classes of schools which may help him, including the correspondence school; correspondence extension branches of certain universities; night schools with their reasonable rates, conducted at certain educational institutions including a number of colleges and trade schools.

Let it be said here, that if at all possible, a college education should be obtained, as it is invariably the most thorough and broadening from an educational viewpoint. There is a tendency in many of the middle grade school courses to confine students to the technical subjects only, and in this way his education in general is apt to suffer, with respect for example to studies in history, grammar, and the various languages, which are required in the course of

study at every first-class academical institution of standing. On the other hand, with a little forethought and guidance from those who are in a position to know, it is possible for the self-educated man to broaden out in his sphere of activities, and to even surpass in education, the college bred engineer. Like most other avenues of human endeavor it depends to a very large extent upon the individual himself. He must, in any event, learn to look up data bearing on certain problems and how to interpret the matter he finds.

There are many state colleges and others throughout the country who make a special effort to reach the student with but slight financial means, and a considerable number of them have a special staff to look after the welfare of new students, especially those who are desirous of working their way through college. With a little help of this kind many a worthy aspirant can obtain a remunerative position covering a few hours each day which will sufficiently reimburse him so that he can follow his studies, and support himself.

The general electrical engineer of to-day is a rare species indeed. Generally speaking, from personal observation extending over a number of years, there are actually but few electrical engineers in the broad sense of the word. The majority of the profession have specialized in certain particular lines. Thus in the telephone field alone, there are thousands of engineers and specialists who have found a fruitful field for all their energies and proclivities. This applies likewise to the telegraph engineering field, as also radio telegraphy, electrical railway work, electric signaling, storage battery research and industrial application, dynamo and transformer design, electrochemistry, hydro-electric development, etc.,

For the information of the uninitiated, it may be said that a great many of the graduates of our engineering colleges and universities find employment with large electrical and manufacturing concerns, while some of them eventually branch out into the consulting engineering business, electrical contracting and its various phases and possibilities.

First, last and always, the engineer, of no matter what *ilk* or *ology,* is forever a student. In ten short years—nay, even in five years, a very marked and appreciable change will have taken place in many branches of engineering, especially electrical engineering, and more particularly in radio work. That is to say then, that the student who graduated five years ago would indeed find himself far behind the times, if he had not studied closely the latest books and periodicals on his chosen subjects as they appeared from month to month and from year to year.

The amount of new literature published in the past few years on electrical and radio engineering, particularly the former, has well nigh promised to completely flatten the pocket-book of any ordinary engineer. The libraries of our large cities provide excellent reading facilities however. Thus it is possible for practically everyone to satisfy his desires in the thirst for more knowledge.

After the engineer or student has gone through his four years or more of difficult studies in algebra, trigonometry, physics and electro-dynamics, *ad lib.,* and even though he has been so fortunate as to provide a respectable private library of the more desirable and important works, covering his line of work, he will find it sooner or later very advantageous to become a member of one or more of the various Engineering and Technical Societies which maintain branches in the larger cities. One does not have to be a resident member of any of these cities to receive beneficial results from such a membership, as practically all of them publish their papers in the proceedings which are mailed to all of the members quarterly, and in some cases monthly, the latter being the case with the American Institute of Electrical Engineers. There have been a number of important papers presented before the Institute of Radio Engineers on wireless subjects in the past year or two, and which certainly never would have reached a great many vitally interested in this line of science, if they had not been on the roster of this organization so as to receive by mail the *Proceedings* containing the different papers.

Of course there is no glory for most of us in graduating as an engineer from any school, and the whole subject boils down to the matter of cold dollars and cents. This is an important subject, and one which should receive early attention from those now actively engaged in the profession. Certain it is that most other professions whether legal, medical, or what not, manage in one way or another to gain worth while emoluments and remunerations for services rendered. The engineer, however, speaking generally, and after his four arduous years of study is expected to work for several years while he is "green," as

(*Continued on page 374*)

COLORED ELECTRIC ILLUMINATION.

During the San Francisco Exposition wonderful electrical illumination effects were used. The photograph here illustrates one of the court-houses at Stockton, California, illuminated with colored electric lamps, instead of the ordinary white ones.

The lighting installation consists of four 500-watt flood lighting units, located on the roof of a three-story building, directly across the street. As this building is the center of a beautiful square, it is planned to light all four sides with twenty projectors in banks of five units each, each bank to be located on the roof of the building opposite each corner of the square.

Unfortunately, the beautiful colored effects of the court-house are not brought out by photographs. Red is used to light the columns at the base of the domes and back of the railings at the center of the domes. The lamps were hidden by reflectors mounted back of the columns and railing. The flood of soft red light was faded into a rose pink by the more intense brilliant white light from the projectors.

A beautiful effect is obtained when the lights are turned on at the approach of darkness. Promptly at sundown the red lights are turned on, which in the early twilight appears a faint pink. As the twilight gradually becomes darker, the colors come up to a rich red, which is again transformed into pink, by the white lights of the projector. Flood lighting lends itself admirably and economically to such illumination schemes.
—*Photo by Courtesy of "Electrical World."*

An Artistic Triumph in Illumination Engineering. Flood Lighting of Court House at Stockton, Calif.

U. S. FIELD WIRELESS IN MEXICO INCREASED.

The power plant of the field wireless station at General Pershing's headquarters in Mexico was doubled recently, inaugurating one of the first of the military improvements suggested by the Mexican campaign.

The sending of naval wireless messages on both coasts of North America can be read nightly by this station, but on account of lack of sufficient power it usually has been unable to send even as far as Columbus at night. Daylight conditions are better for wireless operations, owing to the incessant rattle of static at night.

Several changes in the methods of handling the signal business in the field have been worked out during the two months' experience in Mexico. Division of labor is one of the suggestions.

In the rapid advance on Villa's heels, a single signal company sometimes was strung out over a length of 400 miles so that each man, instead of doing merely the portion of the work in which he was most expert, became a jack of all trades, doing everything from stringing wires over mountains, to copying telegraphic or wireless messages. The signal corps men met the emergency well, and it was pointed out that for real warfare many valuable lessons had been learned.

UNIVERSITY OF KANSAS WIRELESS COURSE.

A course in wireless telegraphy is to be added to the curriculum of the University of Kansas next year. Laurens E. Whittemore, a fellow in the department of physics, will conduct the course, and he intends to make the wireless station in Lawrence one of the largest in the state outside of those owned and controlled by the government.

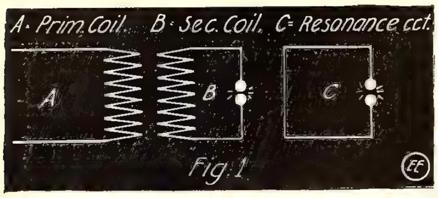
The present outfit established by Whittemore is capable of sending messages more than 1,000 miles and has picked up parts of messages from as far as Key West. The course is expected to prove extremely popular in the next two years.

The Marvels of Modern Physics

By Rogers D. Rusk, B. Sc.

HIGH FREQUENCY PHENOMENA.

CURRENTS of high frequency and high potential exhibit many phenomena which are entirely different from those of ordinary currents. A discharge which would ordinarily be fatal, will not even be felt by

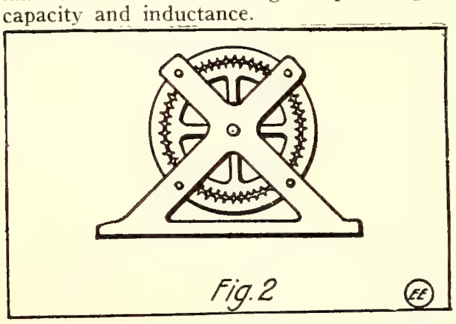


A Closed Wire Loop with Micrometer Spark Gap at "C," Enabled Hertz to Prove the Existence of Electromagnetic Waves in the Ether.

the body if it is of high frequency. An incandescent lamp may be short-circuited by a heavy copper bar and yet such a current will light it, while vacuum tubes may be caused to glow brilliantly without any metal connections at all. This, of course, does not at first seem reasonable until the phenomenon and conditions are explained.

By the frequency of a current is meant the rapidity of its alternations or reversals in direction. Joseph Henry, of Washington, first discovered that the discharge of a Leyden jar or condenser is oscillatory, and Sir Oliver Lodge was able to visibly analyze such a spark discharge by means of a rapidly rotating mirror. This gave him definite knowledge that each discharge, instead of being a single spark, was a quick succession of flashes in opposite directions, beginning with a heavy flash and rapidly dying down to zero. The discharge of an open induction coil will seldom exceed ten thousand alternations per second, while the discharge from a suitable condenser may range from a few hundreds of oscillations per second to several billion, depending on the capacity and inductance of the circuit.

These terms—capacity and inductance—may be more readily understood if they are likened to the elasticity and inertia of a vibrating spring. In either case both qualities must be present in order that vibrations or oscillations shall occur. As a spring swings past its zero to be pulled back in the opposite direction, so does a Leyden jar over-discharge itself, then re-discharges in the opposite direction, and repeats this until the current falls away to zero. Such oscillations generate the familiar electromagnetic waves of wireless telegraphy, and because the oscillations rapidly die out so also do the waves, and we then say that they are strongly *damped*. From the above, one can see in a simple manner how the wave-length depends upon capacity and inductance.

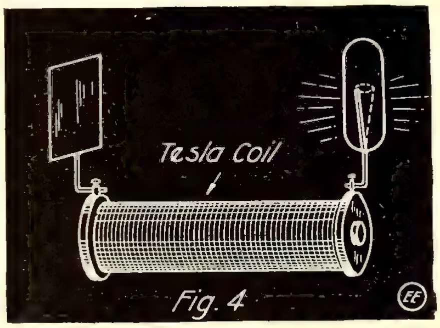


The High Frequency Alternator Produces High Frequency Current by Electro-Dynamic Means.

In order to create more permanent oscillations a source of constant and high potential may be shunted around the condenser, causing a continual process of charging and discharging. The first experiments along this line were performed by Dr. Hertz of the University of Bonn, who used merely an open induction coil. After their discoverer, they are known as *Hertz effects.*

While operating a coil with an exceedingly rapid vibrator, he noticed that sparks were jumping from several metallic objects about the room. By means of his resonator shown in Fig. 1, Hertz was able to prove that certain waves were sent out from the sparking circuit which could be caught by another circuit of proper wave-length, in which they would set up a *sympathetic* current capable of giving sparks. The best position for resonance was readily found by adjusting the length of the rectangle "C," and by placing it in different positions, the plane and direction of the wave was determined. The two circuits responded to each other just as two tuning forks of like pitch will respond sympathetically.

Following up these trail-blazing experiments, Nikola Tesla achieved fame by a number of more striking ones. Tesla determined to produce high frequency currents direct from the dynamo, and with this in view he constructed a number of machines, the plan of one of which is shown in Fig. 2, which he called *high frequency alternators.* The coils are very small and the poles hardly more than fine teeth. With such a machine Tesla was able to obtain a frequency of 10,000 per second,

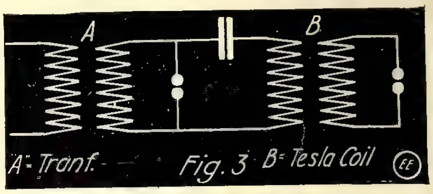


A Thin Wire Inside an Evacuated Tube and Connected to One Pole of a Tesla Coil, Will Rotate as Shown by the Dotted Lines.

and 10 amperes at 100 volts. The machine, small as it was, had 400 poles on the field, 400 coils on the armature and was run at 3,000 revolutions per minute. In a later machine a frequency of 15,000 per second was obtained. Since then others have labored in the same field, Duddell by using an induction disk with a fine toothed edge obtained at first a frequency of 50,000 per second and later the marvelous one of 120,000, although with the latter the current was reduced to .1 of an ampere and the voltage to 2 volts.

Professor Trowbridge, who was experimenting at the same time, produced sparks from 6 to 7 feet long from a condenser discharge which he calculated to be 3,000,000 volts! His method of obtaining such a voltage was simple but ingenious. Using 20,000 small storage cells, he charged the plates of a large condenser which were arranged in multiple. Reversing their arrangement he connected the plates in series and thus had an enormous potential though an exceedingly small current at his disposal. However, he was outdone by Tesla, who by his well-known Tesla coil or secondary transformer, produced a roaring spark of sixteen feet in length in 1900. He virtually reproduced lightning itself by a deafening discharge that crashed between electrodes a hundred feet apart. The voltage was in the billions and the current about 800 amperes.

The secondary transformer or Tesla coil used by him is shown diagrammatically in Fig. 3, where it is readily seen that the current from the induction coil sets up oscillations in the secondary circuit through in-



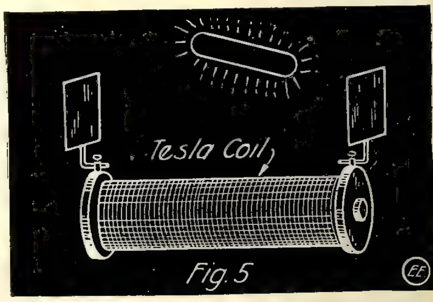
Tesla Scheme for the Production of High Frequency Currents

duction which are of both enormous voltage and very high frequency due to the capacity and inductance of the circuit.

The effect of such a spark on the body is peculiar. Where it strikes the body direct it may be more painful than the ordinary spark, but if made to strike an electrode of some metal touching the body or held in the hand, the whole discharge may be taken without any shock whatever. In such a situation sparks may be drawn from any part of the person and a gas jet may be lighted with the finger without even being insulated from the ground. To prove that an amount of current is really being conducted by the body, an incandescent lamp held in the hand, between it and the terminal, may be lighted.

Two probable reasons are advanced to explain the absence of sensation. In the first place an electric current starts to travel on the surface and spreads in a comparatively gradual manner to the interior of a conductor. When the successive impulses of the current are very short it travels *only on the surface* and therefore it is called the *skin effect.* Secondly, the sensory nerves of the body do not respond to such a short stimulus as probably the *millionth* part of a second.

The above mentioned skin effect is responsible for another statement at the beginning of this article. The larger a conductor is, the less will the current penetrate beneath the surface, and consequently the greater will be the resistance. This is at first a seeming incompatability, but a mathematical investigation will show the exact rule, that the effective resistance to a high frequency current varies *directly* as the diameter of the conductor. Thus if a current is passed through a very heavy bar, the effective resistance of the bar will be so great as to make it possible to light a lamp by touching its terminals only a few inches



An Evacuated Glass Tube Placed in the Electrostatic Field of a Tesla Coil Will Glow; the Forerunner of Wireless Lights.

apart upon the bar, although the lamp might seem to be virtually short-circuited.

Tesla labored long attempting to produce

(*Continued on page 375*)

Editor's Mail Bag

Under this heading are published communications from our readers of general interest to all concerned. In order that letters shall receive proper attention, we earnestly request you to make them as short and concise as possible. This is essential on account of the great amount of mail received daily.

No attention can be paid to unsigned communications, but on request we will withhold the correspondent's name.

EDITOR.

NEW ZEALAND'S MUZZLED WIRELESS.

Editor The Electrical Experimenter:

As a regular reader of *The Electrical Experimenter,* I feel in duty bound to let you know how much I appreciate your excellent publication. The paper has come rapidly to the front in a very short time, and I can safely say that it is one of the finest American periodicals of its kind that reaches these shores. What I particularly appreciate is the Radio Section, which deals with its subject in a really excellent manner.

As you are no doubt aware, wireless (that is, amateur wireless) is absolutely "kyboshed" in New Zealand. The penalty for owning radio apparatus or working an amateur station unlicensed by the Government is no less than £500, or in American coinage about $2,500, or as an alternative five years in the lockup. Truly a pleasing prospect for the potential amateur! How would some of your American amateurs like this? Despite all this, a number of bold spirits had fairly well equipped receiving stations prior to the war, conducted with great secrecy. Of course all of this is absolutely stopped now that "the blast of war blows o'er the land" and New Zealand is at present practically under military control. However, I am, in spite of this, a very keen, though necessarily passive amateur, and hope after the war to establish a good transmitting and receiving station.

I take great interest in American radio apparatus and have the catalog from all the leading experimental supply companies and most of the English catalogs.

H. P. GIBBONS.

Wellington, New Zealand.

[*Our American amateurs, we believe, do not fully appreciate the great liberties they enjoy. New Zealand's wireless amateurs are not only muzzled in war times, but in peace times as well.—Editor.*]

ANENT THE AURORA BOREALIS.

Editor The Electrical Experimenter:

In your December, 1915, issue, under the Question Box, there is a contribution by Lawrence Madison, Kingman, Maine (379). I wish to state my own personal experience during the year 1909, that is, during the winter of 1908-9. I was then living at Portsmouth, N.H., and there was a very beautiful and spectacular display of the Aurora Borealis, which lasted for two or three nights, and I very well remember having discussed the peculiar hissing or crackling noise which accompanied this display at that time. This sounded very much like the crackling noise produced by the static (Wimshurst) machine. For at least two nights during this particular winter Mrs. DuEsler and myself went outside and noticed this very astonishing phenomenon.

Having lived in the east (New York State) for twenty-two years, I have quite often witnessed the ordinary display of the Aurora Borealis, but my New Hampshire experience was very much more impressive and more beautiful, as the lights flickered and seemed to be constantly changing in intensity and then decreasing in brilliancy.

Never before have I had the pleasure of witnessing such an unusual display accompanied by the crackling sound such as I heard back in New England during the winter mentioned above.

As you may see, my experience seems to be a repetition of those related by your subscriber, Lawrence Madison.

O. A. DuESLER.

Vallejo, Cal.

FROM A NEW SUBSCRIBER.

Editor Electrical Experimenter:

I am enclosing the voting blank you sent me the other day and wish to make a few remarks which cannot be placed on the card.

I particularly like descriptions of electrical and mechanical apparatus and circuits, provided that they are described in detail. I did not like the old *Popular Electricity Magazine* very well for the reason that they generally printed articles which were too elementary and anyone knew how the apparatus worked without reading the description. Those articles on apparatus which were not known did not increase the reader's knowledge because they were merely descriptions as an observer would see the apparatus in passing through the plant; very little, if any mention of the principle involved was made and no mention of the circuits, connections and specifications which would give one some idea of the operation. I like articles giving the operating theory of a piece of apparatus at least, and where possible a detailed description of the parts including the size, shape and size of wire, number of pounds or number of turns used, etc.

One of the things I would particularly like to see described in detail in the near future, would be the de Forest Ultraudion Detector-Type U.J.1. I understand this instrument receives both undamped waves and spark signals and I would like very much to get a diagram and explanation of the circuit used, especial attention being given to the difference between it and the ordinary Audion circuit. Also if any repeating or induction or resistance coils are used in addition to the regular Audion circuit, I would like to know the size and amount of wire used in them.

CHAS. KINYON.

Kansas City, Mo.

[*We are pleased to see that the presentation of our articles is appreciated. We try hard to print only constructive as well as instructive articles and as a whole, we believe we are succeeding.*

Regarding Ultraudion and Audion, etc., without wishing to boast, we believe this magazine has published more facts and articles concerning these instruments than all other journals combined. Full References will be found in the following numbers: May, Oct., Dec., 1913; April, May, June, July, Aug., Nov., Dec., 1915; Jan., Feb., March, May, June, July, Aug. 1916.

We would strongly advise new subscribers to secure all available copies of back numbers. These contain a wealth of important articles not to be found in print in any existing publications.—Editor.]

ONE READER'S OPINION.

Editor Electrical Experimenter:

I was much interested in reading some comments in the "Editor's Mail Bag." I was one of your first subscribers away back in 1908, to *Modern Electrics.* You then printed "what the readers want and not what strikes the editor's fancy." It seems to me that if the editor succeeding you had not printed something that struck his fancy, *Modern Electrics* would have prospered to this day.

The average reader does not seem to know just what he wants. He gets a hobby for one thing and then for another. If he sticks to one certain phase of experiments, he becomes narrow-minded along another line.

I have been a subscriber for about a year to THE ELECTRICAL EXPERIMENTER. Before that time I bought the magazine now and then at the news-stands.

I have been more or less narrow-minded myself. I could not see, for the life of me, why it was that the editor continued the story of the "Baron Münchhausen's Scientific Adventures," but after reading a few installments I began to look at improbabilities with the far distant view of probability. I am not much of a wireless fiend although I have a station. My hobby is chemistry. I am glad to see an entry of chemistry in the *E.E.* These first installments seem rather elementary, but in going over them, they certainly refresh my mind a great deal. Your treatise on "Electro Physics" is also of great interest as well as "The Constructor" and "How-To-Make-It" departments.

Many of the articles in the various departments I pass over, sometimes because I am not interested, and sometimes because I have seen similar articles before, but this fact does not lower my appreciation for the magazine because I believe that THE EXPERIMENTER is not published for me alone, but for thousands of others.

Last, but not least, your "Ad." section. I like your "ads" because they are brief, concise and right to the point.

How about it, Readers? Let's get together and make the old phrase "A big I am and a little you," read a "Big you and a little I am," and everybody for THE ELECTRICAL EXPERIMENTER, as a magazine to the interest of everyone.

Yours Electrically and Experimentally,

E. A. NORSTADT.

Joliet, Ill.

[*A constructive letter of value for the editor's guidance. We need letters such as this one and we believe our readers will appreciate Mr. Norstadt's views. The editor has a very difficult task trying to please everyone—there are so many tastes, so many likes and dislikes. Only by telling us your wishes, can we give you the magazine you want.—Editor.*]

New Light Weight Radio Sets for Aeroplanes

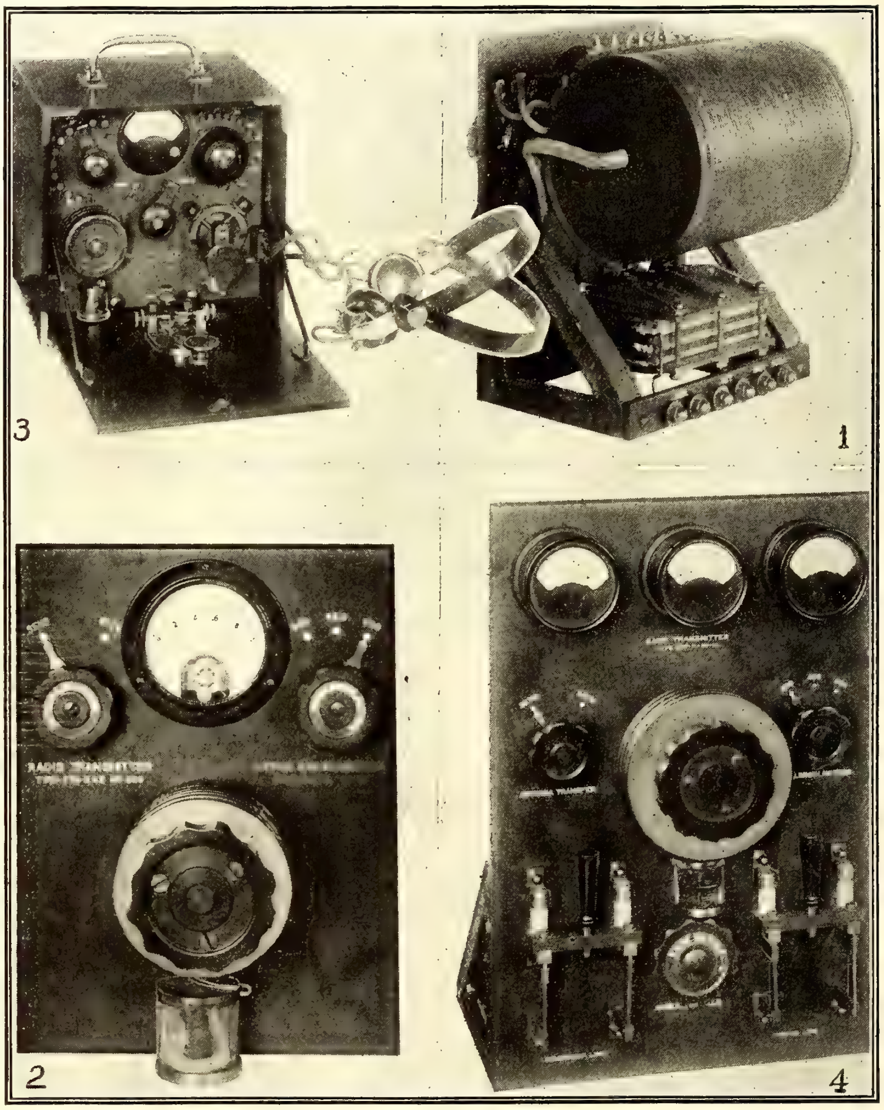
SINCE the commercialization of wireless telegraphy, radio engineers have been trying to reduce the size and weight of the apparatus to make it better adapted to small vessels, field work and aeroplane scouting. Among the results of importance are those obtained by Messrs. Bowden Washington and Fulton Cutting, the well-known radio engineers.

The ¼-k.w. set, Figs. 1 and 2, is intended particularly for submarine and patrol boat work. The panel is of Bakelite. At the left is shown the antenna transfer switch, which changes the antenna from sending to receiving and opens the generator line when in the receiving position. The ammeter registers the current in the antenna circuit. When the set has been tuned to the aerial, a direct indication of the wave-length is given on the front of the panel. In the side view the secondary inductance is clearly shown. Both the primary and secondary coils are wound with Litzendraht cable. No variation of the primary inductance or the mica condenser is necessary when the wave-length of the aerial circuit is changed. The impact excitation of the secondary circuit makes this possible. During each successive half-cycle of the 700-cycle, 500-volt feed circuit, the condenser charges and discharges many times. Each of these discharges consists of a single loop or half-cycle, which may be considered as a blow to the oscillating circuit. The occurrence of each successive blow in proper phase relation to the antenna is insured by the following operation:

We will consider that the gap has just discharged, and set the antenna in oscillation. The condenser immediately charges again and reaches a potential almost sufficient to break down the gap before the wave-train in the antenna has died down perceptibly; therefore the E.M.F. induced in the closed circuit by the oscillating antenna adds a slight increment of potential at the proper time to "trigger off" the gap in phase. This is somewhat like tapping a punching bag and letting it swing back and forth a few times, and at just the proper moment tapping it again, thus keeping it in a practically continuous state of oscillation. These gap impulses naturally occur more frequently during the central part of each feed current loop, giving the antenna oscillations greater amplitude at this point. In fact, the tone envelope of the antenna wave-train is practically sinusoidal, giving a very beautiful note.

This is the best way to excite the antenna for two reasons; the perfect quenching of the gap insures a pure radiated wave, making a sharp tuning at the receiver possible. Since the primary circuit is so highly damped, the aerial vibrates at its own frequency, without respect to the wave-length of the exciting circuit. Thus it is possible to vary the wave-length of the antenna circuit without in any way changing the primary circuit or coupling, a great advantage in changing quickly from one wave-length to another.

In tests made on a ½-k.w. set, the phantom antenna capacity was changed through a ratio of 3 to 1, the secondary inductance from 2 to 1, and the primary condenser 2 to 1, yet the radiation current was changed only 10%. Under favorable conditions this type of apparatus has an efficiency of better than 70%, as against 40 to 50% in most spark or arc sets.



Several Views of Newly Developed Wireless Transmitting Sets of Extreme Value for Aeroplanes and Signal Corps Duty. They Operate on a New Principle, Utilizing a Spark Gap Across the Main Supply Circuit with Necessary Control Inductances, Condensers and Switches.

The gap used on these sets consists of two polished copper terminals in an atmosphere of alcohol vapor, the alcohol being supplied to the gap chamber by a wick. One of these terminals is movable, for the adjustment of gap length. The gap is very short, usually not more than four to six thousandths of an inch. Both electrodes are provided with large cooling fins, air cooling having been found sufficient. As the power in the sparking condenser is equal to

$$\frac{NCV^2}{2};$$

where

N=sparking frequency,
C=capacity, and
V=maximum voltage.

it will be seen that owing to the high spark frequency, many times that of the generator, as a great number of sparks occur to each cycle, much lower voltage is necessary than in the sets of the same power where only one spark occurs per loop. Here is another advantage from the point of view of reduced weight and bulk, since no step-up transformer is required, and the insulation is not as important as in high voltage sets.

The ¼-k.w. set, with an antenna 100 feet long and 60 feet high, consisting of two wires, has an average sending range of 150 miles.

In Fig. 3 a 1/6-k.w. aeroplane set is shown combined with receiving set. The weight of this set is 8¼ lbs., or 22 lbs. complete with a fan-driven generator, and an antenna consisting of a single trailing wire 150 feet long. The frame of the aeroplane is used as a capacity ground. A sending wave-length of 450 meters is used. The 15-point switch at the right

(*Continued on page 376*)

WIRELESS OPENS POLAR SEA ROUTE FOR RUSSIA.

Wireless telegraphy has opened a polar sea route from Central Russia to Great Britain. Wireless stations established by the Russian government in the Arctic keep the vessels advised as to the channels free from ice.

The Obi and Yenessi are huge rivers, with a great depth of water, taking steamers of any size, but it was not until lately that their navigation was put in practise.

SHIP RECEIVES 9,000 MILE WIRELESS MESSAGE.

The American steamship *Ventura* reports that she picked up a wireless message from the station at Tuckerton, N.J., when 9,000 miles distant from that point. This is said to be a world's record.

MOTORCYCLE RADIOPHONE.

The accompanying photographs illustrate a very efficient portable radio telegraph and telephone outfit, carried on a special motorcycle chassis. This compact little radio unit was developed especially for military work by Dr. Lee de Forest.

The transmitting end of this outfit consists of a special double arc quenched gap, on the panel of the rear partition of Fig. 1. The instrument at the right of it is the generator field rheostat. The condenser is of the glass dielectric type enclosed behind the quenched gap. The helix or aerial loading inductance consists of a spiral copper conductor, also mounted in the same compartment. The key on the cover is used for telegraphic sending. The radiophone is composed of the same transmitting outfit, namely, the arc, condenser and helix, which are used for generating the sustained waves, with the exception that a double microphone transmitter is interposed in the aerial circuit instead of the telegraph key. This microphone is at the right of Fig. 2. They are connected together with a single horn so that both are operated simultaneously when put in the telephone circuit. A hot wire ammeter is connected in series with the ground lead to indicate the amount of current radiated by the set.

The current for the arc is supplied from a 500- to 600-volt direct current generator, driven by a two-cylinder gasoline engine, on the same chassis as illustrated in Fig. 1, although the generator is not shown. A large fan is employed for cooling the engine, so that the set can be operated for a considerable length of time without overheating the engine. The dynamo is connected through a large choke coil to prevent the high frequency current developed by the oscillating arc from backing up through the generator. This is mounted on the panel back of the generator. Various other protective devices are included with the outfit.

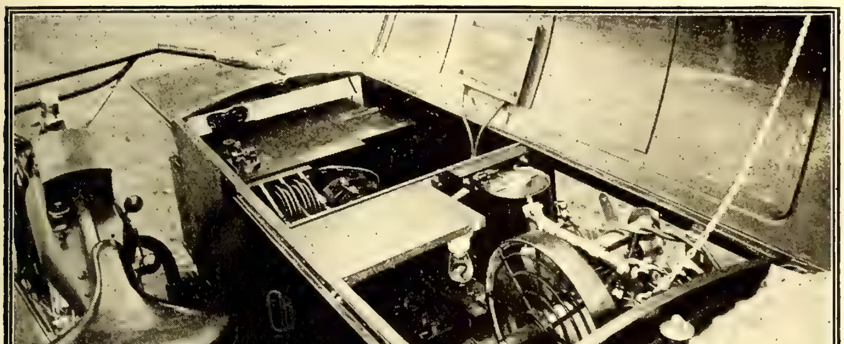
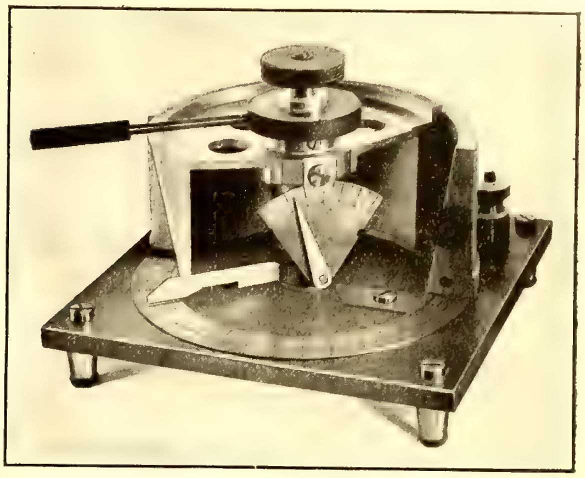


Fig. 1. (Above): View of Motorcycle Engine and Radiophone Generator.
Fig. 2. (Below): The Radiophonic Receptor and Large Microphone for Controlling Arc Current.

A CONICAL VARIABLE CONDENSER.

A very ingenious little condenser has recently been developed by Eugene T. Turney, the inventor of the Crystaloi detector. It consists of two semi-circular cones, one of which fits within the other. These are moulded of special metal composition and are of rugged construction. The inner cone is mounted on a mandrel, supported on a threaded rod so that the inner electrode can be raised or lowered by turning the upper rubber knob. In this way the capacity of the condenser can be varied as the distance between the two metallic surfaces is altered, thus changing the dielectric space, which, of course, changes the capacity. The movable cone is turned by handling the lower knob. A pointer is fastened on one edge of the semi-circular electrode, which plays over a graduated scale as perceived.



New Variable Condenser for Radio Receiving Circuits. The Inner Cone Turns and Also Rises Within the Outer Cone. Provided with Calibrated Scales.

Seven different capacities can be obtained by varying the position of the movable cone with respect to the stationary. Several hundred graduations of capacity are obtainable, however, by utilizing both lateral and vertical adjustments of the rotatable inner electrode. The scale and pointer mounted on the movable electrode indicates the lateral position of the cone.

The complete condenser is mounted on an insulating base, fitted with two binding posts for making connections. This condenser is, perhaps, the only instrument that will give more individual capacities than any other of its construction and size. It is suitable for laboratory work where many different exact capacities are required.

The receiving instruments consist of an Ultra-Audion, capable of receiving damped and undamped wave stations. The detectors controlling the apparatus are on the lower left side of the stand, Fig. 2. The two multiple switches on either side are employed for varying the high voltage current in the detector, while the knob in the center controls the current through the filament. The two double-point switches on the bottom control the Audion tube, so that it can be used for either receiving sustained or damped wave stations.

The aerial loading and condenser apparatus are enclosed in a separate box, which is seen at the right, below the microphone. This cabinet contains one loading coil, taps from which are brought to a multi-point switch placed on top of the cover. The capacity of the set consists of two large variable condensers which are controlled by knurled rubber handles projecting above the cover. These instruments and the vacuum detector are connected by means of four

(*Continued on page 376*)

HIGH TENSION CONDENSER SWITCH.

The illustrations are quite complete and so detailed explanation seems unnecessary. By a close study of Figs. 1 and 2, the construction of the switch will be readily understood. The letters refer to the same parts in each figure.

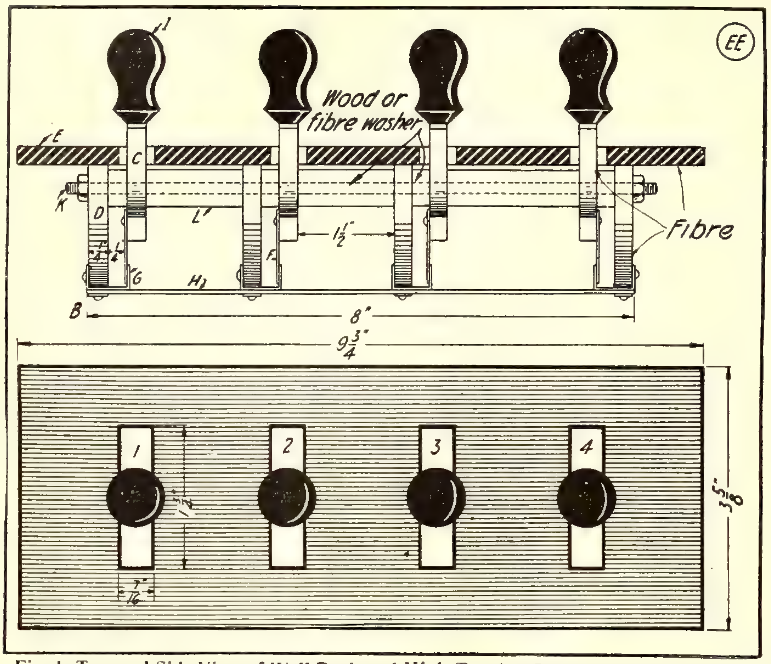


Fig. 1. Top and Side View of Well Designed High Tension Radio Condenser Switch. Handles have a To and Fro Rocking Motion, Movement of Hand Being Very Small.

A_1, A_2, A_3 and A_4 are terminals to be connected as indicated.

B is terminal to be connected as indicated.

C is of fibre, exact shape shown in Fig. 2.

D is of fibre 2¾" long, 1-11/16" wide.

E is of fibre 9¾" long, 3⅜" wide.

F is of copper fastened to C with machine screws.

G is a copper or brass shoe bent as shown in Fig. 1.

H is copper or brass strip to connect all B terminals.

I is of ebony or some other hard wood turned as indicated.

J is of copper or brass bent to come in contact with F.

K is a brass rod threaded and has a nut on each end.

L represents wooden washers to separate D and C.

In switching in various condensers sections the following schedule is useful:

For 1 plate use No. 1.
For 2 plates use No. 2.
For 3 plates use No. 3.
For 4 plates use No. 3, 1.
For 5 plates use No. 3, 2.
For 6 plates use No. 3, 2, 1.
For 7 plates use No. 4.
For 8 plates use No. 4, 1.
For 9 plates use No. 4, 2.
For 10 plates use No. 4, 2, 1.
For 11 plates use No. 4, 3, 1.
For 12 plates use No. 4, 3, 2.
For 13 plates use No. 4, 3, 2, 1.

This switch may be used to good advantage in sets of almost any size. Its electrical capacity may be greatly enhanced by immersing the switch gear in transformer oil. Also a second contact may be mounted on D, opposite contact A, thus doubling the utility of the design here proffered.

Contributed by ERNEST OKE.

REGARDING TIKKERS FOR UNDAMPED SIGNALS.

There have been numerous descriptions of tikkers given in the various magazines. While some of the designs are very good, there are others which have their disadvantages. For instance, all tikkers which depend upon alternating current for their action, such as "relay tikkers," will work only when the sending station is relatively nearby. This is due to the interference caused by the alternating current hum. It is much more noticeable when using the sensitive mica diafram 'phones. Then there is the type of tikker which uses a small battery motor to rotate a wheel, either commutator or grooved pulley, with a wire resting in or on it. This type has the following disadvantages: the spark at the brushes of the motor, however small, will be distinctly audible and prove a nuisance unless especially guarded against. Theoretically it can be overcome by making a tuned circuit of very short wave-length of this spark by shunting it with a small inductance and capacity in series, but no case in which it has been done with success has come to my notice. The tikker which I use and which is described herewith overcomes all of the foregoing deficiencies.

The first thing to procure is an old phonograph motor, the cylinder type being preferable. I purchased mine at a second-hand store for a very small sum. Remove everything but the motor and the screw which controls the speed by adjustment of the governor. Next procure a wheel between two and four inches in diameter with as many cogs on it as possible. The brass driving wheel from an old magneto, which has about 180 cogs, will do very well. Fill the spaces between the cogs with shellac so that the brush will run smoothly. This is done by using thick shellac and allowing each coat to dry by baking it before applying the next one. When the shellac is thick enough to cover the cogs, bake it well over a *slow* heat so it will not melt and run. After it is well hardened file off the excess shellac, leaving a perfectly smooth wheel with alternate segments of brass and shellac.

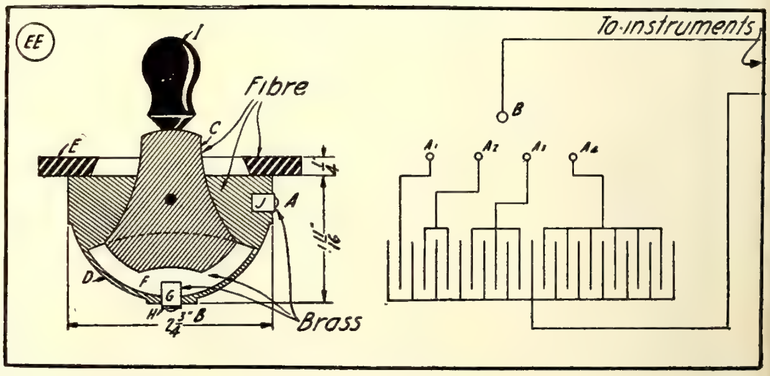


Fig. 2. Details of High Tension Condenser Switch, Including Connections Giving Various Capacities.

Secure the wheel by a suitable bushing to the shaft of the motor which formerly turned the record spindle. After arranging a small strip of spring brass to act as a brush, the tikker is ready for use. The reason for using a wheel with many cogs is obvious. You may run the phonograph motor at a very low speed which will allow it to run a considerable length of time and still give a fairly high note in the 'phones.

Contributed by W. A. PARKS.

SHIP OPERATOR HEARS MANY AMATEURS.

In this and many other magazines I have read of amateurs who made claims of exceptionally long distance work in sending and receiving. Being an operator on a third-class ship, I thought I would tune for a 200 meter wave and see what came in! The results astounded me! I heard a great many stations and following is the list of stations which came in loudest on each of three successive evenings: January 17, 1916, ship's position 100 miles southwest of Diamond Shoals Lightship, at 11 p.m., copied 2SX (New Rochelle, N.Y.), working 8 MW. Distance about 480 miles. January 18, 1916, 11:10 p.m., 300 miles southwest Diamond Shoals, copied 8 NH (St. Mary's, Ohio), working 8 QB. Distance 650 miles. January 19, 1916, 10:30 p.m., eighty miles north of Jupiter, Florida, copied 8 AEZ (Lima, Ohio), working 8 OU. Distance 900 miles. No special apparatus was used in receiving, a Telefunken receiver and a galena cat-whisker detector being used.

Contributed by S. TONNER.

TIMELY HINTS TO ELECTRICIANS.

An electrician who is not familiar with or does not follow accepted standard practice in his repair and installation work is a constant menace to the safety of any establishment and its employees.

Shield your eyes from electric arcs or flashes. This kind of light frequently causes temporary blindness and in some cases ruins the eyesight. If you ever become so affected, consult your physician at once.

Small cuts, bruises or burns should receive treatment immediately and be protected from dirt or mechanical injury. Blood poisoning may set in and must be guarded against.

Keep your eyes on your hand when reaching for electric switches. Otherwise you may touch the "juice."

Before working on electric machines *lock* the service line switch *open* and place the key in your pocket. No person can then turn on the current with fatal results to yourself. This has often occurred.

Screwdrivers, pliers and all other handy tools should have insulated handles.

Immediately stop any abuse or misuse of electrical apparatus.

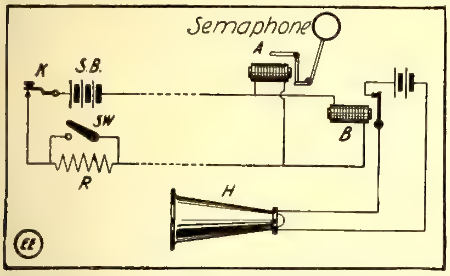
Never work on live circuits unless it is absolutely necessary. If you must work on such circuits, use all the safety devices and methods possible.

Treat all wires as "live" until you are absolutely sure they are "dead."

A SIMPLE TIME SIGNAL.

The following is a description of a simple arrangement for sending out time received by wireless. Such a system as this is in use at the University of Iowa.

The necessary parts are a semaphore A, a relay B, an electric horn H, with two or three dry cells to operate it, a key K, a six or twelve volt battery SB, and a resistance R, arranged so that it can be short-circuited by the switch SW. The relay is wound so that it will operate on a smaller current than will the semaphore. The value of the resistance must be such that, when in the circuit, it will limit the current to such an amount that the semaphore will not be tripped and yet will allow enough to flow to energize and close the relay. The proper value can easily be found by test. If it is not possible to obtain a small semaphore, one may be made from a telephone drop such as are used on the magneto type of switchboard.



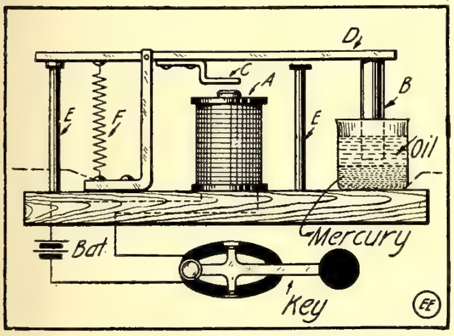
Pressing Key K with Resistance Switch SW Open Closes Relay B, Operating Horn H. On the Hour SW Is Closed, Key Then Operates Semaphore A.

The following method of operation was found by trial to be the most satisfactory. When the time signals are received the operator presses the key and gives a long warning blast on the horn at one minute to the hour. At ten seconds to the hour a shorter blast is given. Then the switch S is closed and exactly on the hour the key is pressed again, causing the semaphore to fall and the horn to sound at the same time.

Contributed by RE.

ANOTHER OIL-BREAK KEY.

The telegraph key here illustrated is capable of handling the heavy currents used in wireless transmitting. It consists of a pivoted arm, D, made of brass or copper, with a copper contact rod, B, at one end. The soft iron armature, C, is screwed to the underside of D and is attracted by the magnet (or magnets) A. These may be taken from an electric bell. The contact rod B dips into mercury contained in a small seamless brass or glass receptacle. Over the mercury is poured a little transformer oil. The rod B should dip in the mercury about 1/16". A small coiled spring can be used to break the contact. The stops E, E, should allow the arm to swing about 3/16". An ordinary telegraph key is connected in series with two dry cells and the magnet A.



Oil-Break Key for Handling Heavy Currents. It Can Be Made From Odd Parts at Slight Expense.

This key will handle, if necessary, the current for a 1 K. W. transformer. It may also be used with a break-in system by arranging auxiliary insulated contacts on the arm D.

Contributed by G. W. COOKE.

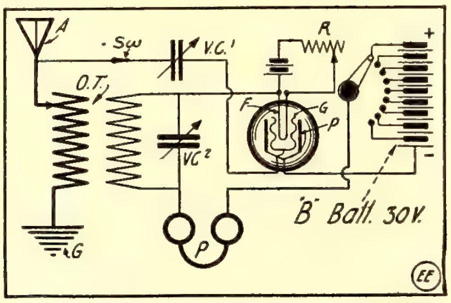
AN ULTRAUDION HOOK-UP.

By L. M. Westcott, U.S.N.

A receiving set using an aerial composed of six wires, 60 feet high and 100 feet long, has covered a distance of 4,800 miles at night, using the apparatus described in this article. The day-light range is ordinarily 2,000 miles when receiving from high powered stations.

The Audion detector used with this set is the ordinary second step amplifier bulb, having two plates and two grids. The unique part of this receiver is the connection of the grid to the antenna, through a variable condenser. A switch is employed, however, to open the circuit when undamped oscillations are being received. For undamped stations this connection is used. When receiving from the ordinary spark transmitters, this type of connection is equal to any of those on the market.

Experimenters using this circuit may encounter a slight amount of trouble in tuning, but a little experience will give results that are quite surprising. The adjustments are very delicate—a slight adjustment of either the primary or secondary will throw the set completely out of resonance. It is absolutely necessary that the primary and secondary windings are adjusted to the same wave length to make the bulb oscillate properly when receiving undamped waves. This is easily accomplished after a little practice, for when the bulb is oscillating a slight hissing and popping noise may be heard in the receivers.

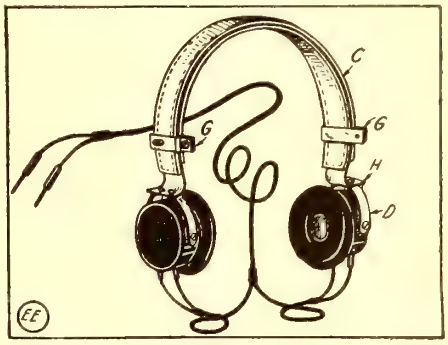


An Ultraudion Hook-Up Worth Trying on Your Set

The tuning of this outfit is different from the ordinary Audion. The fine tuning is done by means of a variable condenser and the primary switch, with little variation in the coupling. A loose coupler for receiving waves up to 10,000 meters has a primary coil 7 inches in diameter and 14 inches long wound with 700 turns of No. 26 single silk covered wire. The secondary is 6 inches in diameter, wound with 1,000 turns of No. 30 single silk covered wire. When the condenser V_2 has a capacity of approximately .0004 M.F. this set will tune all stations up to 10,000 meters. The condenser V_1 should have about the same capacity. For long waves the secondary should be about half way in the primary, but for short waves the coupling must be very close. Taps on the secondary should be about 50 turns apart to allow for close tuning with the shunt condenser. The bulb will oscillate best when using about 25 volts of the "B" battery. Ordinarily it is burned at medium brilliancy, that is, consuming not over ½ ampere.

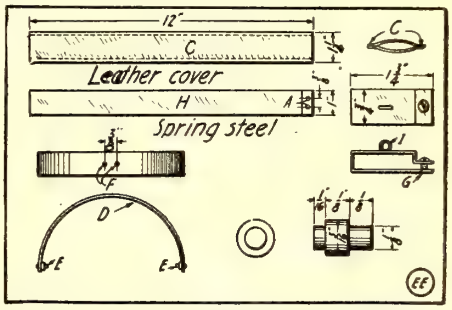
An interesting characteristic of this set is the similarity of the tone which it gives to the incoming spark frequencies from 100 to 500. Over this range there is little difference between the pitch or tone of the signals. Arc signal frequencies can be changed at will by a slight variation of the coupling or the variable condensers. This receiver has been used with very good results in connection with radiophone work.

AN ADJUSTABLE HEAD BAND FOR 'PHONES.



Appearance of Assembled Home-Made Head-Band for Radio or Telephone Receivers

For those who have no head band to hold their 'phones a simple one can be made from a clock spring. The spring I used was from an old alarm clock and measured 1 inch wide. This head band will require two spring strips, each 12 inches long by 1 inch wide. At the end of both strips two ⅛-inch holes A, each ⅜ inch apart, are drilled (first annealing the spring) and the end bent upright as shown. A cover is made for these two strips, by sewing two pieces of leather 12 inches long and 1¼ inches wide together, along their edges C. Two metal strips, each ⅜ inch wide and a little longer than half the circumference of the receiver, are drilled with two small holes F, each ⅜ inch apart, and tapped to receive a small screw. These pieces are bent to form half a circle D. The two ends of D are fitted with two pivots E E, which are riveted into a ⅛-inch hole. Two holes are bored in the side of each receiver. The pivots E E fit into these holes and form bearings in which the receivers can turn and thus automatically adjust themselves to the ear. The pieces D are held to the strap H by two screws which pass through A. The leather covered bands are made adjustable for any head by means of two clamps G. Their form and construction may be best understood from the drawing. A small screw eye is cut in half and soldered to the center of the clamp so that the receiver cord may be passed through the eyelet. If you connect the receivers as shown, you can omit the screw eye on the clamp, as the flexible cord does not go over the head band at all in this case.



Parts Making Up Home-Made Head-Band Including Leather Cover for It.

Contributed by
AN EXPERIMENTER.

Do you believe in Female Radio Operators for the future? Well, whether you do or not, see what you think of the situation after reading our interesting article, *The Wireless Girl*, in the *October* issue.

THE CONSTRUCTOR

Building a 110-Ft. Iron Pipe Radio Mast

By Samuel Cohen

IT is the desire of many enthusiastic radio experimenters to erect high aerials, especially when situated in localities where highly elevated masts are necessary to obtain good all around efficiency from their apparatus. However, masts exceeding the fifty foot limit are somewhat difficult to build and erect, and this work is properly intended for riggers, although they cannot always be obtained. The purpose of this article is to tell the amateur how to build and erect a 110-foot radio mast.

The mast consists of seven sections made from galvanized iron pipes of decreasing diameters. Each measures 16 feet long, except the last or highest, which is fourteen feet long. The diameter of each pipe is given in the diagrammatical sketch, Fig. 1, which illustrates the general layout of the mast. Each pipe is connected with the adjacent ones by means of stock reducers, the sizes of which are also given in the drawing. The lower part of the three-inch pipe is fitted with a tee, in which is fitted an iron plug C, pointed as shown. This is made by procuring a three-inch pipe, about two feet long and shaping it o a point, by placing it into a blacksmith's furnace and heating it to redness, then hammering the end until the proper shape is secured. In the side opening of the tee at B, a three-inch pipe A, about sixteen feet long, is fitted. This is used for erecting the mast when it is completed.

The central portion of the pole is fitted with a three-way tee, D. Three 1¾-inch pipes, E, E and E, are obtained, six feet long. These are fastened in the openings of the tee. The ends of these pipes are secured with standard malleable iron eyehooks, F, F, F, to hold the guy wires. This section of the mast can be seen in the top view, Fig. 2. Each pipe is placed at 120° angle from the adjacent one.

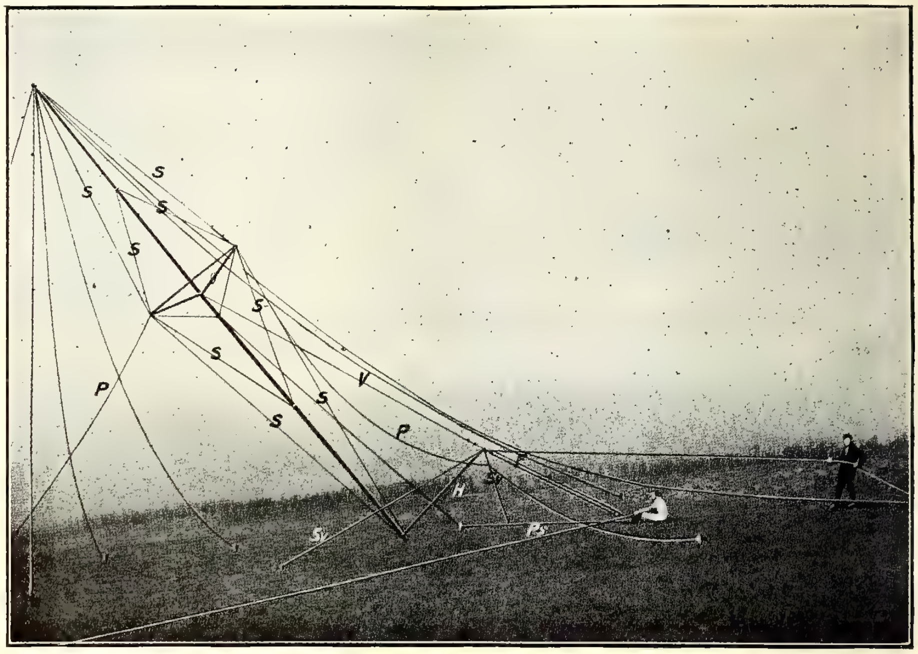


Fig. 4. The 110-Ft. Iron Pipe Mast Being Raised by Two Men. Details of Construction Given Herein

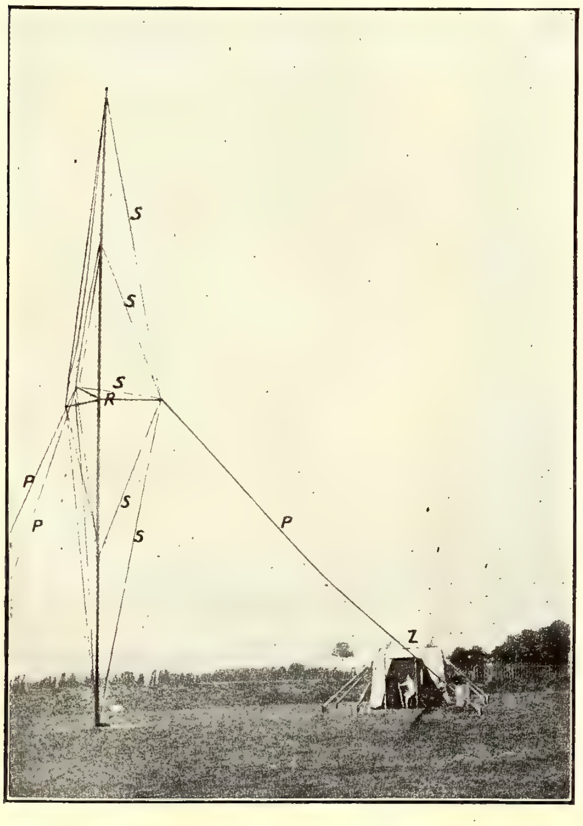


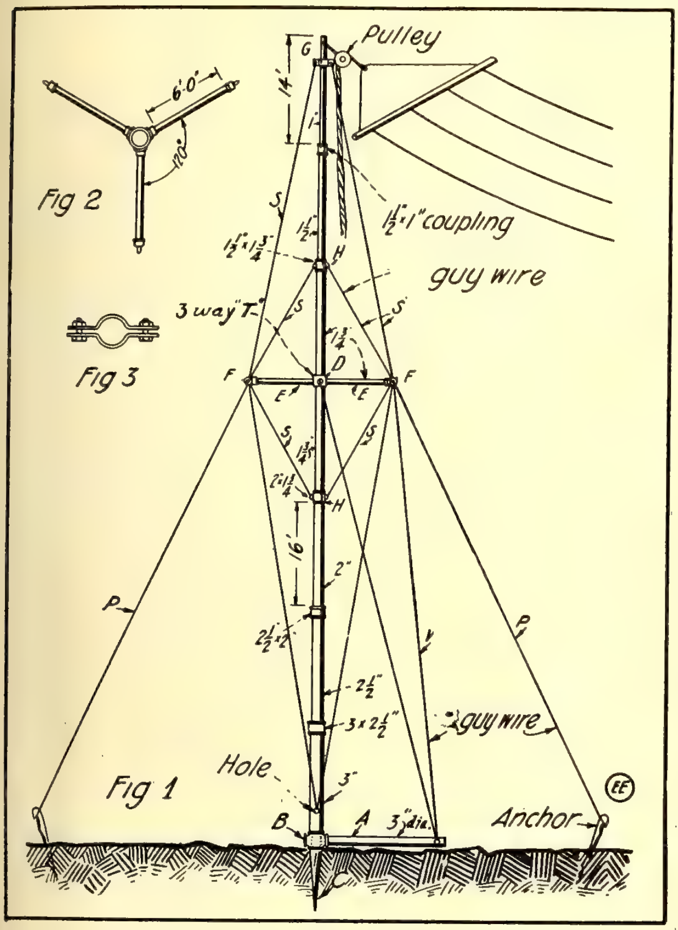
Fig 5. The 110-Ft. Iron Pipe Mast Fully Erected and Radio Station in Tent.

When all the pipes are ready, the next step is to assemble the mast and thoroughly guy the various points along the mast. Before rigging up the parts, the reducing couplings should be properly covered with white or red lead, to prevent the formation of rust on the threads. It is advisable to construct four wooden horses for supporting the various portions of the mast when assembled. It will be found worth while to build them, as it will save a considerable amount of time and labor. The next step to be taken up is to guy the various portions of the mast and also fastening securely the support guys. First construct three guy hooks, Fig. 3. These are made from ¼-inch galvanized strap iron, bent in such a manner as to fit tightly around the pipe. They are held together by two ¼-inch machine screws. Galvanized guy cable, 5/16-inch diameter, is connected to the various points as illustrated in Fig. 1. All the guys marked "S" should be tightened, and care exercised to see that the shape of the mast is not altered when the guys are tightened. It is thus advisable to use turn buckles if the cable is to be properly adjusted. The three lower guy wires are fastened to the mast by passing them through a ⅜-inch hole drilled through the pipe. The support guys P, P, P, are about 100 feet long. The next thing is to paint the mast with three coats of heavy lead paint, of a color to suit the builder best.

The experimenter may think the work of erection difficult, but he will not find it so if the following directions are properly carried out. The first requirement is a good position to place the mast. At a radius of 80 feet from the mast drive three stout iron or wooden anchor posts about six feet long, at an angle to the ground, see Fig. 1. By placing another anchor block about 20 feet from the base, and fastening to it a (preferably a triple or quadruple) block and tackle the whole mast can be raised about 15 degrees to start the pointed plug C into the ground. By allowing two men to pull on the free rope of the tackle, and two men to take charge of the free guy wires, the erection of the mast is much simplified. Fig. 4 illustrates this angular position of the mast when the hoisting was started. The man to the extreme right had charge of a swinging guy cable, which helps to support the mast, as it will be found that when the pole is in an angular rising position, it manifests a tendency to swing around, and will have an inclination to fall. It is also advisable to employ a couple of swinging (free) guys fastened to base extension A. By continuously pulling on the tackle rope, it will be found

that no difficulty will be encountered in erecting the pole. In fact it should not take more than one-half hour to set the mast in a perpendicular position. The various guys are then firmly secured on the anchor blocks. Two short pins are forced into the earth on either side of pipe A, so that the whole mast does not tend to turn.

The complete erected mast is illustrated in Fig. 5, with the radio operating room at the right. The latter was built out of pipes and canvas. The rapidity of erecting



Details of 110-Ft. Radio Mast Composed of Progressive Sizes of Standard Iron Pipe, Joined Together by Reduction Bushings.

such an antenna makes it extremely satisfactory for field and portable use, if the various sections are made light.

The radio experimenter will find the erection of a high aerial mast as described above very efficient, satisfactory, and low in cost, which is perhaps the most important item to the amateur.

REMOVING ENAMEL FROM MAGNET WIRE.

Although there is a certain prejudice against the use of enameled wire for tuning coils and couplers, many operators prefer this kind of wire. There is one great trouble experienced when winding coils with the finer sizes. It is that the wire itself is scraped and often broken in removing the enamel. The only way to remove the insulation without injuring the wire is to pass the wire quickly through the flame of a bunsen or alcohol burner, so that the enamel melts and drops off. A slower way, but better for the smaller sizes, is to dissolve it in amyl-alcohol. This method is also useful when wire is to be accurately measured by micrometers or calipers in the work-shop.

Watch for the "Wireless Girl" in next issue!

A UNIQUE ELECTRICAL CENTER-PIECE.

By P. C. Grose

A young bachelor wished to entertain three of his lady friends at a little dinner which he sought to make extremely novel. A unique centerpiece which he originated greatly enhanced the effect he desired.

From a library-table lamp the shade was removed. A large cylindrical shade was constructed to take its place. Being made of paper and cardboard, this was light enough to have its entire weight rest upon the little conical point of glass at the extremity of the electric light bulb. The top portion of the shade was made of stiff round cardboard. In the center of the under side of this disc a small piece of dented tin was attached so as to rest on the point of the bulb. Around this central point, extending laterally from it, a series of triangles were marked and spaced so that when each was cut on two adjoining sides and bent downward into the interior of the shade at an angle of about 45 degrees, the effect would be a horizontal windwheel. As the lower part of the shade swung free of the lamp pedestal, the only contact at all being the glass point and the dented metal, there was so little friction that an almost imperceptible atmospheric current passing through the windwheel would cause the shade to slowly revolve. The upward flow of the heat from the enclosed electric bulb produced such a current.

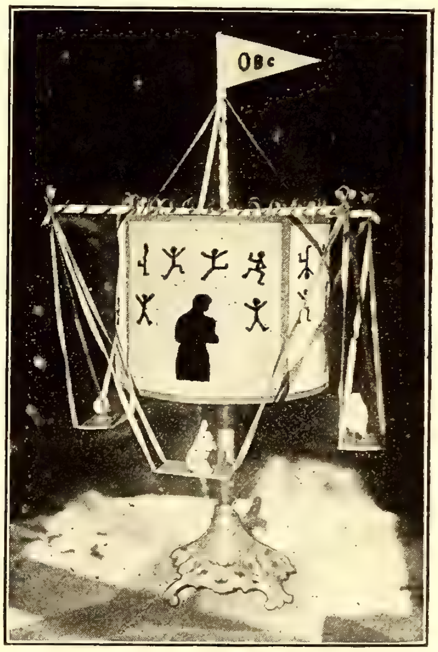
The outward part of the shade was divided into four equal sections. A different color of heavy bond paper was used for each section. From a freak kodak picture an enlarged silhouette drawing was made of each one of the party. These were cut from heavy black paper and one pasted in each section of the shade.

Using the "Dancing Men" code, described in the chapter "The Adventure of the Dancing Men" of A. Conan Doyle's "The Return of Sherlock Holmes," the first six letters of the christian and surname (the latter only when the first had less than six letters in it) of each member of the party were placed in the respective sections. They, too, were cut from the black paper and pasted onto the bond. As "dancing men" for only part of the letters of the alphabet are shown in the chapter mentioned, imagination served in creating additional ones when a name required it.

A little pennant surmounted the shade while from four lateral arms ribbons supported toy animals, each of these being the favorite pet of the person in front of whose section it swung.

When lit up and slowly revolving, it had a mellow, subdued impressiveness. The endeavor of the guests to determine which of the pictures and names was their own while revolving before them formed one of the interesting features of the dinner.

Lingering over the last course, the dinner ended merrily with such questions (the members took turns in suggesting them) as "Which one of us will die wealthy?" "Which one of us is a thief?" "Which one of us will be the first to marry?" The answer to each question was obtained by turning off the current to the lamp in the centerpiece. The one to whom the pennant most nearly pointed when it had stopped was the "victim."



This Novel Table Decoration Revolves by the Heat Liberated From 32-C. P. Bulb.

A SIMPLE WIRE GAUGE.

Drive a ¾ inch nail into a block of wood until it projects exactly ½ inch. Wind the wire of unknown gauge tightly around the nail and count the number of turns; double it, then refer to the table here given. For the smaller sizes it is only necessary for the nail to project ¼ inch; then the number of turns must be multiplied by 4.

Size B. & S. Gauge	Turns Per Linear Inch: Enameled	Single Cotton	Double Cotton	Single Silk	Double Silk
20	29	25	23	27	26
21	32	28	26	31	29
22	36	31	28	34	32
23	41	34	31	38	36
24	45	37	33	42	39
25	51	41	36	47	43
26	56	45	38	52	46
27	64	49	42	57	52
28	71	54	45	63	56
29	79	58	48	70	62
30	88	64	52	77	67
31	100	69	56	85	72
32	112	75	60	93	78
33	134	81	64	102	84
34	140	87	68	112	91
35	156	94	73	120	97
36	173	101	78	130	104
37	201	108	84	141	110
38	225	115	89	151	117
39	256	122	95	163	123
40	288	130	102	178	129

DOUBLE COTTON

Size B. & S. Gauge	No. Turns Per Linear Inch	Size B. & S. Gauge	No. Turns Per Linear Inch
4-0	1.70	7	6.08
3-0	2.00	8	6.80
2-0	2.32	9	7.64
1-0	2.65	10	8.51
1	2.99	11	9.56
2	3.36	12	10.60
3	3.80	13	11.88
4	4.28	14	13.10
5	4.83	15	14.68
6	5.44	16	16 35

Contributed by ALBERT CONRAE.

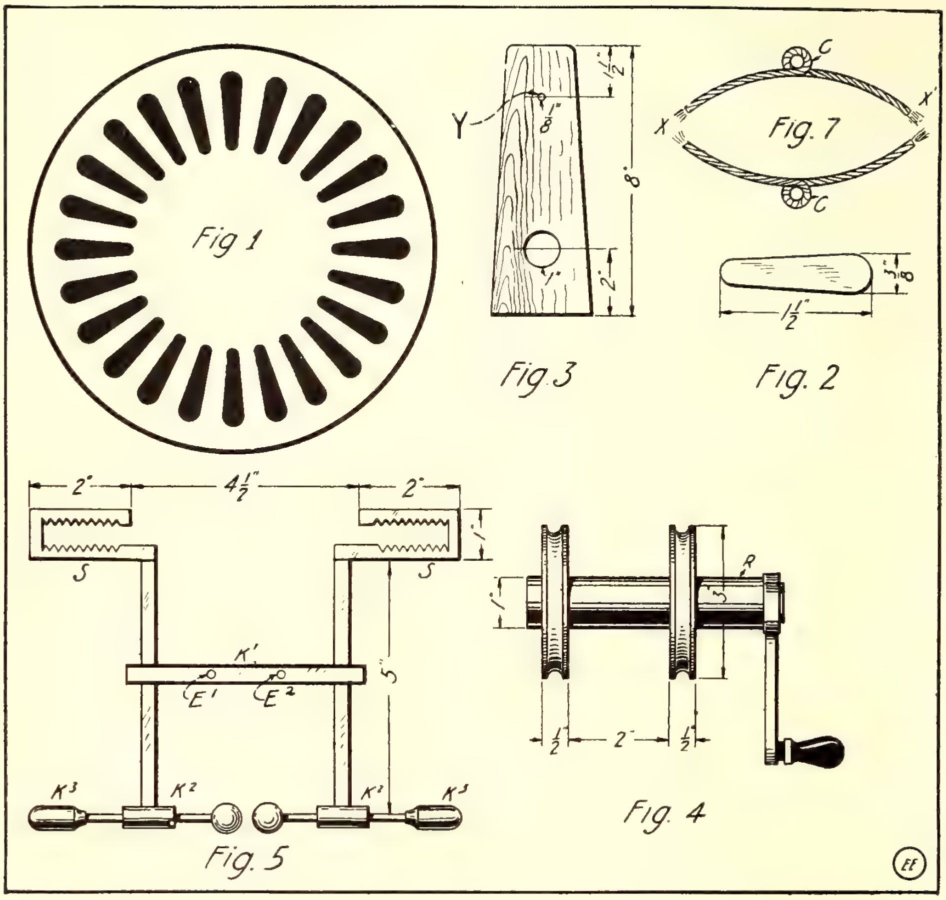
A Small Static Machine

By Leonard R. Crow

The static machine shown in the accompanying illustrations is capable of producing a 2½ to 3 inch spark and may be constructed at a very small cost; in fact, at almost no cost.

The size of the base may be as the builder desires. All that is necessary is that it be large enough to hold the uprights firmly, shown in Fig. 3.

We now come to the collecting combs.



Details of an Unusually Inexpensive Static Machine Which Gives Sparks from Two to Three In. Long.

First procure two phonograph disc records that have been worn out, each to be 8 inches in diameter. Divide the discs into 24 equal segments, marking all the divisions. This should be done on the smooth side of the record. Next the plates should be covered with shellac and thoroughly dried. As soon as they are dry repeat the process.

In the meantime 48 small pieces of zinc or zincfoil should be prepared, zinc is preferable if procurable. If neither is to be had, heavy tinfoil may be used. These pieces should be cut into the shape shown in Fig. 2 and the dimensions indicated should be carefully followed in cutting.

When the plates are perfectly dry give them another coat of shellac, and while still wet place the pieces of zinc with the narrow ends toward the center of the disc, on the previously made radial marks, as indicated in Fig. 1.

The next step is to turn from wood two small pulleys measuring 1 inch in diameter and 1½ inches in length. If access to a lathe cannot be had the builder may make these by hand, but in this case he must be very careful to make them perfectly round. With extra thick shellac stick these pieces on the plates over the holes that are in the center of the records, being very careful to get them centered *exactly*. The most difficult work has now been completed.

The stand is to be made from well-seasoned and thoroughly dried wood; hardwood is preferable. Cut two such pieces as shown in Fig. 3.

The collectors may be made from sheet brass or copper (tin may be used). Heavy copper wire should be soldered to the parts containing the teeth and run to the oscillators; this wire should be heavy, the heavier the better. Nothing smaller than No. 10 gauge should be used and No. 4 is not too large.

Referring to Fig 5, K^1, K^2, K^3 are made of hard rubber or hardwood. The screws pass through the piece K^1 at E^1 and E^2 and fasten the collector to the frame. The hard rubber plates revolve through the teeth shown at S, Fig. 5.

The two neutralizers are to be made next. These should be constructed from brass or copper wire, about No. 14 gauge or larger, and bent as shown at C, Fig. 7. Light brass tinsel can be soldered on the end as shown at X and X^1. If the tinsel cannot be obtained, the small-stranded wires from regular lamp cord may be used. Screws are fastened through the loops shown at C, thus fastening the neutralizers to the standards.

The pulleys are represented in Fig. 4. It is not altogether essential that they are exactly this size, but they should not be changed very greatly.

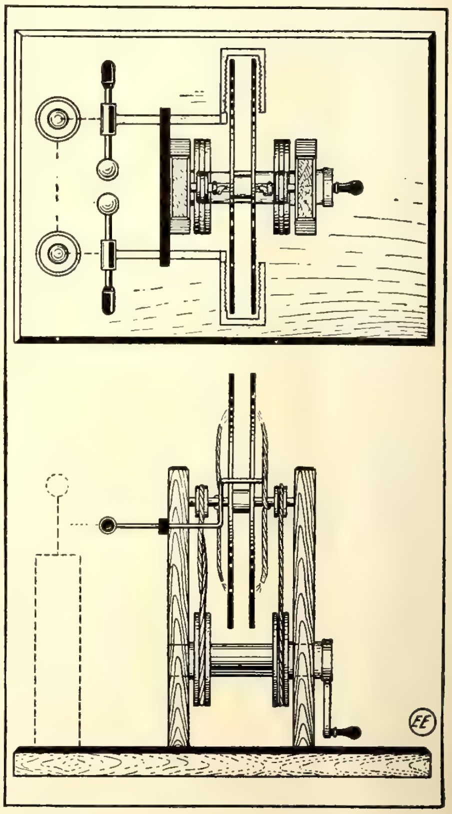
A small crank fits on the end of the shaft at R. This shaft should fit the pulleys tightly. Two belts are required from the larger pulleys to the smaller ones that are mounted on the plates and provided with small grooves to receive the belts. Old sewing machine belts prove very satisfactory.

One belt should be twisted one-half turn so as to reverse the rotation of one plate as compared to the direction of the other.

The plates are held in place and revolved around a ⅛-inch steel or iron shaft extending through the holes bored in the standards shown at Y, Fig. 3.

If the instructions are carefully followed out a very successful static machine will be the result.

The relative position of the neutralizers is best found by experiment. It is, of course, understood that a neutralizer is placed on each side of the machine and



Top and Side View of a Three Inch Static Machine.

not both on the same side, as I knew of one amateur doing.

HOW TO DEVELOP X-RAY PHOTOGRAPHS IN FULL DAYLIGHT.

It is rather troublesome when giving a demonstration with Radiographs to resort to the dark room to develop the plates. If prepared according to these directions, the plates can be developed in full daylight. Wrap the dry plates in two thicknesses of red blotting-paper, or, if possible use filter-paper, and expose as usual. Put a mark on the film-side of the wrapped plate so as to place it in the correct position, i.e., film side upwards during exposure.

After the plate has been exposed, pour the developer into a dish and immerse the plate. The developer will soak very quickly through the blotting-paper and act on the film.

The time of development must be determined by several trials, but with Radinal 1:10 about 6 to 8 minutes will be sufficient to develop the plate completely.

After this time the plate, still in its envelope, is transferred to the fixing bath. After it has been in this for about 5 minutes the wrapper may be removed and the plate examined. The negative is then washed and dried as usual. When printing X-ray photographs, print always on glossy gaslight or bromide paper as this stock brings out much more detail than matt paper.

Contributed by C. A. OLDROYD.

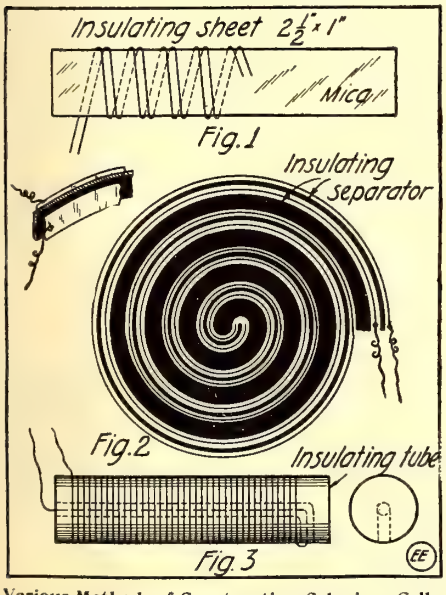
Making Selenium Cells

By Homer Vanderbilt

SEVERAL articles have already been written on the properties of selenium cells, but little practical information has been given on the actual construction of these wonderful light-sensitive cells.

The experimenter who wishes to make the apparatus must first choose a room where the fumes of the molten selenium metal will be driven out, as they are very poisonous. A table near a window is convenient, but no draft should be created, as the temperature of the cell must be kept constant while it is being heated. The next consideration is the use to which the cell will be put. Since this is so essential, several kinds of cells, with their characteristics, will be described. Very little, however, can be said regarding the sensitivity factors. In fact, it is difficult to find or to construct two cells equally sensitive.

One of the simplest forms of selenium cells is the Bidwell type, which consists of a flat, insulated sheet, wrapped with two separate bare wires in a single layer, each of which is insulated from the other, Fig. 1. The insulating sheet consists of a small piece of mica or glass. The former is preferable as it will stand high temperature without being ruptured. The size of the sheet will depend upon the size of the selenium cell, but a piece of mica measuring 2½"x1" is a convenient size. It will be found that such a cell is suitable for practically all sorts of work, such as in the transmission of photographs over a wire, and in television, where large flat cells prove very effective. Two No. 30 B. & S. bare copper wires are wound closely about this mica as shown in the sketch. Extreme care should be taken in keeping the two wires separated from each other and at the same time keeping them very close. If the two wires were widely separated, the resistance of the selenium cell would be very high and thus the sensitivity of the cell would be decreased. A good method of keeping the wires closely spaced and at the same time not short-circuiting them, is to make a number of grooves with a knife in the edges of the mica sheet,



Various Methods of Constructing Selenium Cells, Including the Flat grid, Edgewise Spiral and Cylindrical Forms.

which must be equally spaced and in which the wires are wound. The diagram clearly shows how it should be made. The method of applying the selenium will be described later.

A second type of flat selenium cell is illustrated in Fig. 2, which is also readily built, and consists of two long strips of brass or copper, insulated from each other by a thin sheet of asbestos or mica, then rolled as shown. With such an arrangement a finer selenium cell can be constructed, as the two conducting surfaces are very close to each other, and at the same time are equally distributed throughout. A cell of this type should be constructed with No. 24-gauge brass sheet about 4 feet long by ⅝ inch wide. The asbestos should also be ⅝ inch wide and 1/32 inch thick, the thinner the better. The two strips with the insulation between them should then be rolled up tightly as shown. It is advisable to use a soft grade of sheet brass as it is easier to work with.

This form of selenium cell will be found to be just as good as the first. In fact, it is far more rigid than the other, and for rough use this type is strongly recommended.

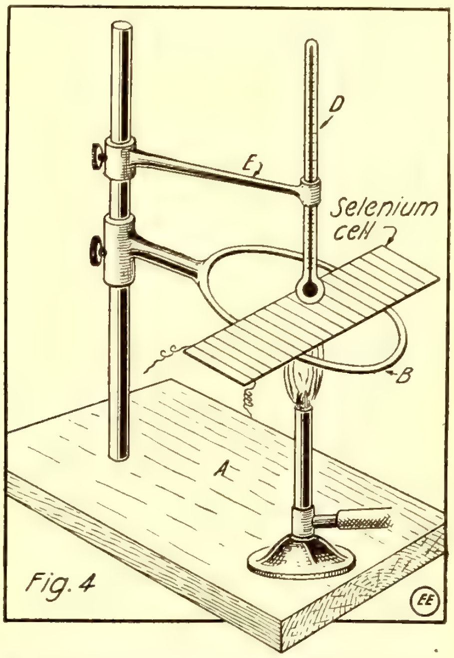
Still another cell of the tubular type is shown in Fig. 3. This form of cell will be found very satisfactory in places where a large active surface cell is required. Experiments on the determination of the intensity of the sun and radiophonic experiments can readily be performed with this type, as for such work a cell having a radial active surface is urgently required.

The wire skeleton is wound on a cylindrical insulating tube, such as glass or porcelain. The latter is advisable, as it is less liable to break when heated. A porcelain tube 3x⅝ inches is the best size, and it can be obtained from any electrical house. On the tube wind two No. 30 B. & S. bare copper wires. The operation should be exactly as for the flat cells, but greater care must be taken in winding the wires, as they are more apt to short circuit than with the other type.

When the skeleton of the cell is made the next and very important operation is the application of the selenium to the wires and to render this material sensitive to light. This last operation is called annealing. The process of annealing is vitally important, as the sensitiveness of the finished cell will depend upon the process.

In order to perform this operation successfully, the following apparatus will be required: A stand A, Fig. 4, having a 6-inch ring B, and a holder E, in which a 200°C. thermometer D, is placed. A standard form of laboratory Bunsen burner must also be obtained. The apparatus should finally be arranged as observed. The next step is to apply the selenium, which must be chemically pure. The selenium must be applied to the skeleton of the cell as follows: Place the form on the ring stand as illustrated in Fig. 4 and heat it with the Bunsen burner until the stick of selenium will melt when brought to the surface. It should not be heated higher than 212°C. Several drops of selenium should be put on the wire grid, and with the aid of a knife blade distributed equally over the complete grid area. Care should be taken to make the selenium surface very thin; in fact, it should be almost, and if possible quite, transparent. Having done this, the unfinished cell is allowed to cool slowly.

We now come to the annealing of the selenium. This may be accomplished by placing it on a strip of mica under which the Bunsen burner is placed. The flame is slowly increased until the surface of the selenium turns a dull gray color. The flame should not be increased after the first signs of melting appear. If melting is observed, the burner must be quickly removed and the flame reduced. The dark gray spots will harden in a few seconds, after which the flame should be reduced and left for two to three hours with the temperature



How the Selenium Cell Is Carefully and Very Slowly Annealed. A Thermometer Is Essential and Can Be Mounted as Shown.

just below, but never above, the melting point of the selenium. The annealing process is then completed by allowing the cell to cool very slowly as the flame is gradually lowered and finally extinguished.

Another method of annealing the selenium is to place the unfinished cell in an oven and heat it for eight to ten hours. After it has been annealed it is cooled quickly.

The process of applying and annealing the selenium is the same for all types of cells so that it is not necessary to explain the details for the other forms.

The resistance of each cell will depend upon the manner in which it is built, so that no definite statement can be made as to what the resistance of the cells will be.

This article should interest the experimenters at this time particularly, since it is so difficult to purchase selenium cells now.

[*Contrary to general opinion selenium in its pure state has an enormously high resistance and can not be used on a cell grid by simply melting it on. It must be crystallized by annealing to render it conductive. The resistance of a stick of C.P. selenium is practically infinite. — Editorial Note.*]

MOVIES CAN BE PRODUCED NOW FROM THE NEWSPAPERS.

Substitution of paper rolls for celluloid films in moving picture machines is made possible by the new "cold" light discovered by a French engineer named Doussaud, which is described to the Academy of Science by Professor Branley, with whom Doussaud studied. The new light is obtained by automatic separation of heat rays from luminous rays.

The light obtained is so intense that images from newspaper illustrations, picture postcards and photographic prints can be thrown on a screen in a lighted room as clearly and sharply as if they were glass lantern slides.

Frequency Meters

By Milton B. Sleeper

THE frequency meter is one of the most puzzling circuit measuring instruments used in a radio or power station. It is rather difficult to understand why a change in frequency or number of complete current reversals per second should cause the indicator to move, or the different reeds to vibrate—depending upon which type of meter is used.

The Westinghouse direct-reading and the Frahm vibrating-reed meters represent the

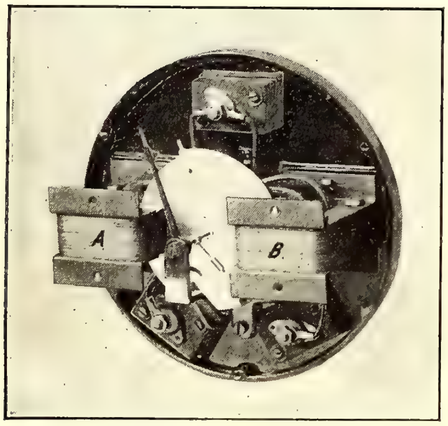


Fig. 1. Commercial Design of Frequency Meter. Direct Reading Type.

principal types of frequency indicators. Fig. 1 shows the front of the Westinghouse type with the scale removed. In this instrument no springs are used; the pointer is controlled by the turning action of two high resistance voltmeter magnets, acting on an aluminum disc which is mounted on the pointer shaft. These magnets are connected to a separate resistor and reactor, Fig. 2. When the current passes through coils A and B eddy currents are set up in the aluminum disc. On the lower poles of the magnets are copper rings. As the magnets are energized, a flux is also set up in the rings, but it is out of phase with the flux of the magnets. This produces a turning torque as the arrows indicate. With a meter on a sixty cycle current, for example, the resultant torques of the magnets are balanced when the pointer is at the center of the scale. A slight increase in the frequency, however, unbalances these forces, for, while the current through the resistor remains the same, the current in the reactor will decrease—owing to the increase in the reactance and total resistance, due to the increase in frequency.

Now the magnet A will exert the greater

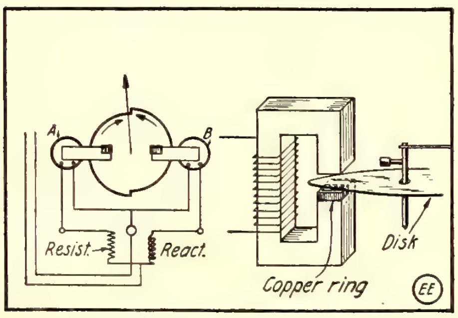


Fig. 2. Connections and Arrangement of Parts in Westinghouse Frequency Meter.

torque. If the disc were perfectly round, it would revolve as in a watt-hour meter. However, the disc is so shaped that as it turns under the influence of magnet A practically the same amount of metal is in the A-gap, but more and more is in the gap of magnet B. Thus the effect of the magnet A is the same, but the effect of magnet B is increased until the forces again balance. *The torque of each magnet is proportional to the square of the current and the frequency.* The left-hand edge of the disc is nearly an arc of a circle having the shaft as its center, but the right hand edge has its center above the shaft. As actually constructed, the edges are *not true arcs*, but have been determined experimentally, to give a uniform scale reading.

This meter is accurate for voltages 25% below and 25% above the normal. Ordinarily it is used on currents of 60 cycles. The greatest advantage in this type of meter is that it indicates directly the fractions of divisions on the scale. It is not, however, as permanently accurate as the vibrating reed type.

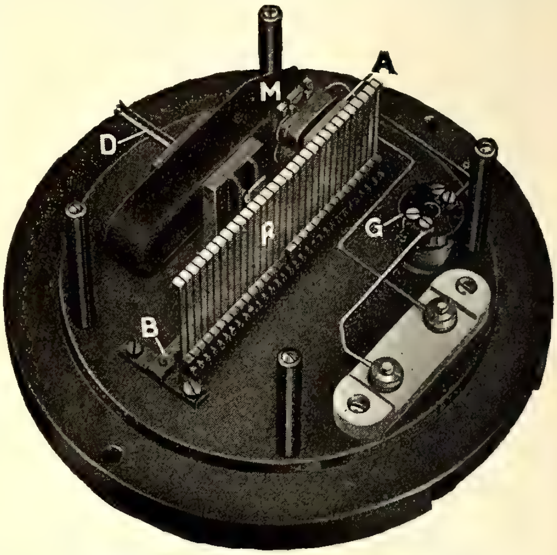


Fig. 3. Frahm or Vibrating Reed Style of Direct Reading Frequency Meter.

The Frahm Meters operate on an entirely different principle. They have no pivoted parts, but use a number of tuned reeds which vibrate in resonance with the current frequency. Fig. 3 gives an idea of the construction. The reeds R, usually 3 mm. wide, made of tempered steel are screwed to a bridge, B. This is attached to the armature, A, of a magnet, M. When the meter is connected across the circuit the current passes through a series resistance, G, and the magnet. At every alternation of the current an impulse is given the armature, and *that reed, which has the same period, vibrates in resonance.* To make the indication plainer, the top of each reed is bent at right angles and painted white. It might seem that this step by step method would not be satisfactory, for the frequency might not be exactly in resonance with the vibrating period of any reed. As a matter of fact, this is not true, as Fig. 4 shows. Here the frequency of the current is exactly sixty cycles, but the reeds on both sides vibrate slightly.

By changing a single switch, an additional coil can be cut in. It has the permanent magnet as a core. Now the changing current causes the magnet to alternately repel and attract the armature, giving one vibration to the reeds for each cycle instead of two. Therefore, the frequency is twice the scale reading. This gives a double range. The usual scale covers a range of 5 to 30 cycles, with intervals of 0.25 to 1.0 between the reeds.

This type of meter is more permanent than others, although it is a little more difficult to read at a distance or when several harmonics are present. They possess, however, the distinct advantage that one or more frequencies may be read on them simultaneously, a condition which often occurs in research work.

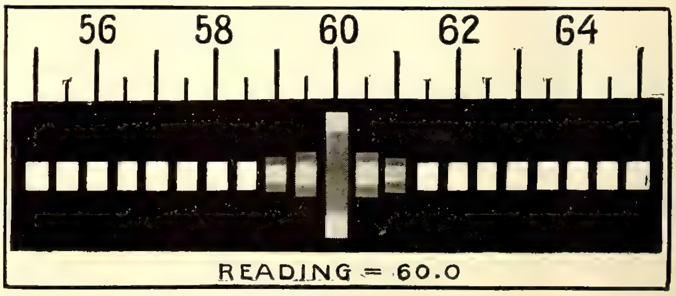


Fig. 4. Appearance of Dial on Vibrating Reed Frequency Meter. The Reeds at Either Side of the "60" Reed Vibrate Slightly as Seen.

For those who have motor generator sets a frequency meter is a necessity if the motor is to be kept running at a constant speed. Those who do not need to use such an instrument should not, at least, become non-plussed when they are questioned regarding them. Moreover, the examinations for operators' licenses usually cover frequency meters.

THE ADVANCE OF RADIO.

The dominant place of the United States in wireless work is one that the country should be proud of and make every effort to maintain. The Government experts, the commercial companies, and the unattached scientists and inventors who sepcialize in this line, taken together with thousands of amateur enthusiasts, make a unique combination that is capable of accomplishing great results either in war or peace.

That the work on wireless apparatus is not apt to lag from want of enthusiasm is shown by the records of the patent office. More patents are being applied for on improvements in radio devices than in any other field except automobiles and airships. Some of the patents are impracticable, but many are in direct line with recognized needs. Considerable advance has been made in dispatching railway trains by wireless instead of by ordinary telegraph or telephone systems. It is predicted that another five years will see radio dispatching in general use. During the severe blizzard of last January, when telegraph wires were down, the D. L. & W. wireless station at Hoboken, N.J., kept in touch with a number of snow-bound trains.

DAY RADIO RECORD ON PACIFIC BROKEN.

What is considered to be a record on the Pacific for daylight wireless work with vessels at sea from land stations was made on March tenth last, when the Federal Wireless Station at Honolulu picked up the noon position of the American steamer *Sierra*, owned by the Oceanic Steamship Company of that city, 1,620 miles west of Pago Pago, American Samoa, or 3,920 miles from Honolulu.

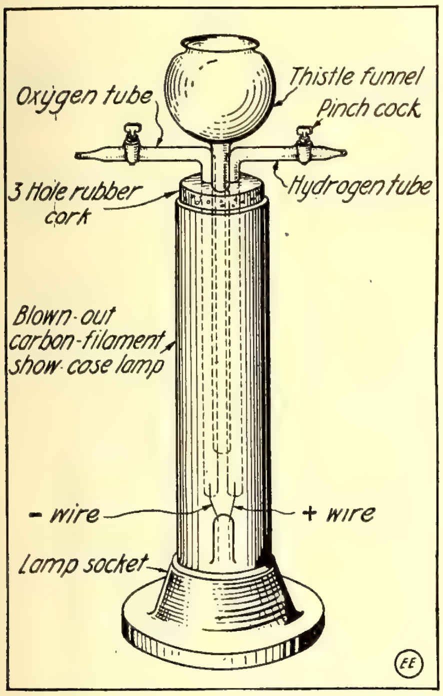
This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.

The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00

ELECTROLYTIC CELL FOR THE DECOMPOSITION OF WATER.

This cell is constructed from a blown out lamp of the tubular, or show-case type,



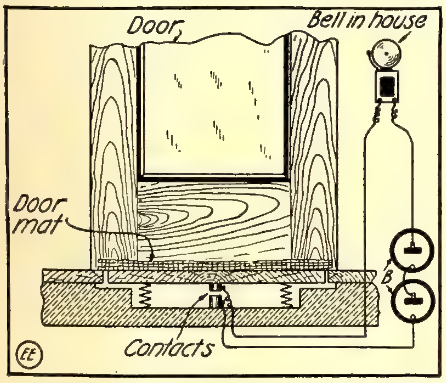
Three Glass Tubes, a Rubber Cork and an Old Incandescent Lamp Make a Capital, Electrolytic Cell

the top of which is cut off and replaced by a rubber cork having three holes in it, through which the glass tubes and funnel are placed as shown. It takes up little room as it may be unscrewed from the socket and put away when not in use.

Contributed by E. T. JONES.

A DOOR MAT SIGNAL FOR VISITORS.

All that one has to do is to wipe his feet on the door mat and "mine host" is in-



When the Hobo Steps Upon This Electric Alarm Mat His Presence is Announced Forthwith to All Present.

formed that someone awaits without. The operation is so simple that even a small poodle dog can let his master know that he would gain entrance by simply coming to the door and stepping on the mat.

A thin board 12"x18" is fastened to the underside of the mat. It is supported on springs which keep it up from the floor beams as shown. Two copper rods are fastened to the bottom of the board and the floor. These should be long enough to touch each other when the board is pressed down. These rods, or a spiral, if it is used in place of the rods, are then to be attached to a battery and bell inside the house. A mat will induce people to step on that certain spot to wipe the dust and dirt from their shoes and so inform their host automatically of their presence.

The mat extends over the edges of the board just far enough to hide the cracks. The movement is so slight as to be unnoticeable.

This device, which serves the purpose of a push button, is much better because it saves time, extra trouble and is, on the whole, very convenient to all, including the pet poodle dog.

Contributed by JULIUS GREENBERG.

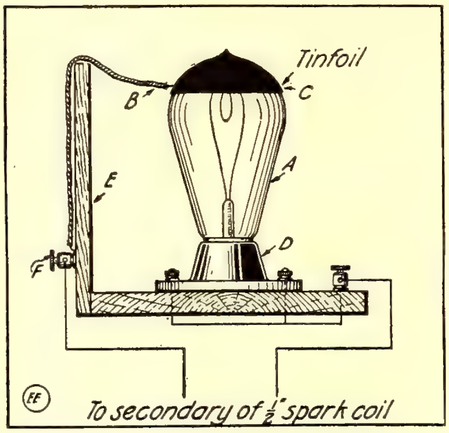
SECOND PRIZE $2.00

USING INCANDESCENT LAMP AS X-RAY TUBE.

First make a base about 5x5 inches, of hard wood. In the center of this base mount an ordinary lamp receptacle. Now put a binding post on one side of the base. Join both connections of the lamp receptacle to this post. Next secure a burned out carbon bulb and place it in the receptacle.

Fasten a small strip of wood E, to the side of the base opposite the binding post. This strip should be the same height as the bulb. Paste (do not use shellac) a small strip of tin foil C, around the end of the bulb. A fine wire is secured to this foil. The end is fastened to the top of the wood strip and brought to the binding post at F. When connected to a spark-coil, this apparatus gives a discharge like an X-ray tube.

The writer has never been successful with a tungsten bulb as the discharge breaks the filament and the glass. Different shapes or sizes of bulbs may be used and the effect is different. While this instrument will not perform the work of an X-ray tube the



Experimental X-Ray Tube Constructed Out of Lamp Bulb. Tinfoil Covers Top of Bulb as Shown.

discharge formed and the principle involved are the same.

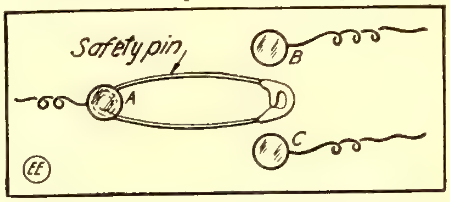
Contributed by VERLIN CONDEE.

THIRD PRIZE $1.00

A "SAFETY-PIN" SWITCH.

Herewith is a sketch of a *safety-pin* switch which I am contributing to the "How-to-Make-It" department. This switch may be quickly constructed from a medium sized safety-pin in emergency and several large thumb tacks serve as points. It can be placed almost anywhere.

Contributed by WALTER JORDAN.



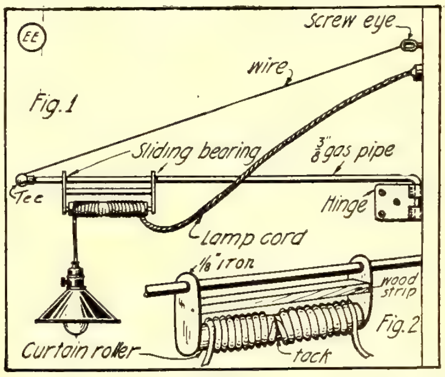
Battery Switch Made From a Safety Pin and a Few Thumb Tacks. What Next? Why Not Use Collar Buttons for Insulators?

AN ADJUSTABLE SHOP LIGHT.

The materials required for this handy shop lamp are 10 or 12 feet of 3/8-inch gas pipe, threaded at one end to fit a "T" fitting and bent at the other end to fit part of a gate hinge. Also a few feet of guy wire to string from end of pipe to screw eye on wall directly above gate hinge and a few inches of 1/8-inch by 1 1/4-inch strap iron with which to make the holder for a window curtain roller about 14 inches long. Some lamp cord, a rosette, socket and lamp complete the material list.

The gate hinge is placed about 8 feet above the floor; the screw eye about 4 feet higher.

Any vertical adjustment of this lamp is cared for by the curtain roller. It may be swung sideways on the gate hinge and for-



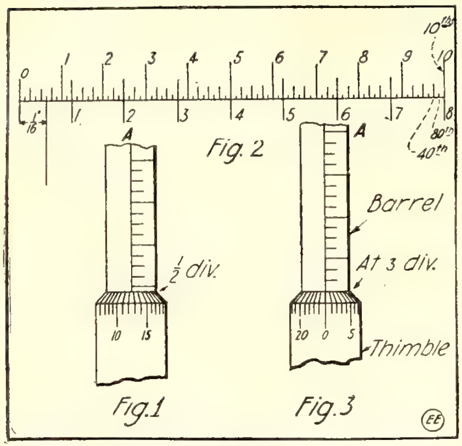
By Using a Shade Roller for the Drum of this Shop Light it May Be Placed at Any Height and Kept There.

ward and backward by sliding the curtain roller holder along pipe.

Contributed by AN EXPERIMENTER.

SETTING A MICROMETER TO READ SIMPLE FRACTIONS.

By means of a reference-table or the fractional equivalents stamped on the frame.



Simplified Scheme for Reading Fractions on a Micrometer. Every Electrician Will Find This of Extreme Value.

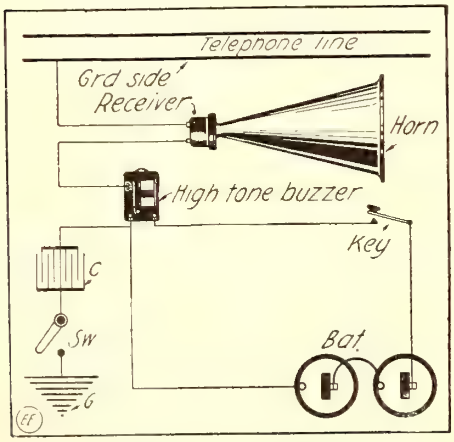
it is easy enough to read fractions from a micrometer, but where a large number of different sized pieces are being calipered, or a rapid method is needed, it requires too much time to refer to the table of equivalents. A simple method of reading eighths is made clear in Fig. 2.

The divisions above the horizontal line represent the marks on the stationary *barrel* of a micrometer. There are ten major divisions, representing tenths of an inch. Each one of these spaces is divided in four parts, equal to one-fortieth of an inch. Now, bearing this in mind, it is easy to read eighths or sixteenths directly. It is plain that five small divisions on the barrel equal one-eighth of an inch, or fifteen spaces equal three-eighths. In making these measurements, the thimble, or rotating scale, must always stop with zero on the A scale. The number of fortieths on the A scale, divided by five, gives the reading in eighths of an inch.

If sixteenths are to be measured, the scale on the thimble will stop at 12.5 on the barrel. Now consider that there are eighty divisions on the barrel instead of only forty. When the thimble is set with 12.5 over the A scale, Fig. 1, the number of eightieths of the A scale, divided by five, gives the reading in sixteenths of an inch.

SIMPLE METHOD OF TELEGRAPHING OVER A TELEPHONE LINE.

Any experimenter may telegraph over the telephone line by arranging his instruments



Method of Rigging up Loud Talker Horn and Buzzer for Telegraphing Over Telephone Circuits.

as shown in the drawing. There will be no need of placing the receiver to the ear.

A friend and I have used this method for some time.

Contributed by HUGH SCHLIESTETT.

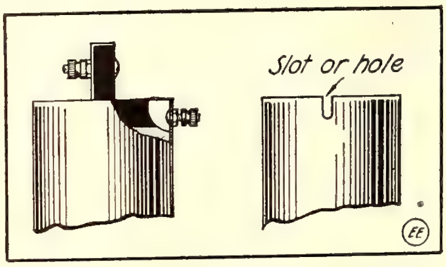
THE AMATEURS' OWN HANDY-BOOK.

Most amateurs possess old catalogues which they usually throw away. Many of these contain valuable information such as wire tables, rules and formulas, call lists and so on. If the pages containing the information are cut out and bound together in some simple manner with stiff cardboard covers they make a really serviceable *Handy-Book.*

Contributed by JOHN B. RAKOSKI.

REPAIRING DRY CELL TERMINALS.

Having broken several negative binding posts off dry cells I hit upon this plan to fix them: Make a small hole the size of the binding post in the zinc where the post was broken off. Dig out the compound around this hole and clean it with a file or sand paper. Obtain a binding post from the carbon of an old battery, and after cleaning it, put



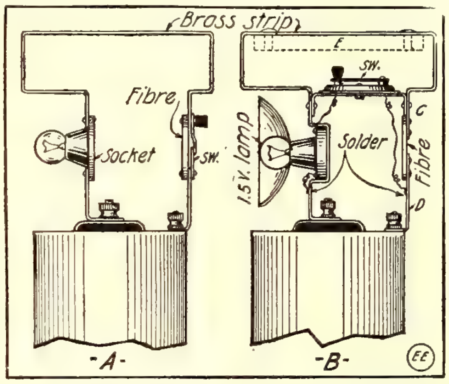
How to Secure Loose Dry Cell "Zinc" Terminals.

it in the hole and tighten the nut. Then fill up the hole in the top of the battery with molten pitch or sealing wax. The end of the screw may have to be cut off a little to make it the proper length.

Contributed by HUBERT CHIDDIX.

DRY CELL LAMP AND SWITCH.

A handy dry cell lamp with switch attached is shown in the illustration. At Fig. A is one type, capable of being made

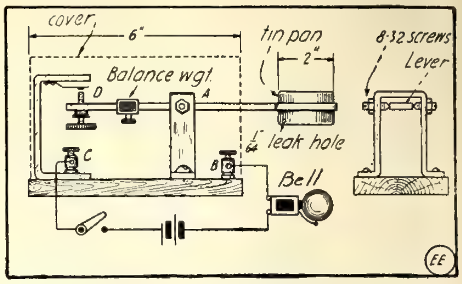


Two Suggestions for Home-Made Dry Cell Flashlights, Incorporating Handle and Switch.

by anyone handy with tools, while at Fig. B is another. The metal strap can be about 1/32-inch by ½-inch or ⅜-inch stock in either case. The former design has the advantage that no wiring has to be used, but the carrying handle is not as strong as the design at B. Here a fibre block has to be inserted between straps, sections C and D, or it may constitute a handle and insulating block combined as at E. A 1.5-volt tungsten lamp is fitted into a porcelain or brass receptacle as perceived in the drawing. The switch arrangement in Fig. B is the more convenient of the two suggested, as the touch of a finger will close or open it without having to remove the hand from the handle.

AN ELECTRIC RAIN ALARM.

This electric rain signal apparatus is fastened on the edge of the window sill with the pan outside. The wires connected to B and C run to the battery and bell as indicated. A strong wind may ring the bell by blowing the pan downward, but if the



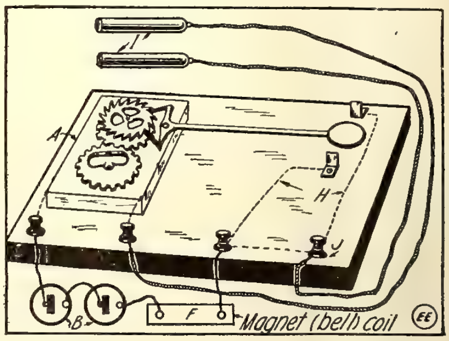
This Electric Rain Alarm Rings Bell When Bucket Fills Up. A Device of Wide Adaptability.

adjustment is correct it will take a very high wind to do this. Of course, the bell will not ring when it first begins to rain, but it will in a few minutes or as soon as there is enough water in the pan to overbalance the lever A. Silver or platinum contacts D serve to close the bell circuit when sufficient rain has accumulated in the catch pan. The instrument should be covered over as shown with a tin hood, through one side of which the lever A projects. A small sliding balance weight is mounted on the lever to admit of accurate adjustment of the outfit. It should be so balanced that a slight over-weight on the pan side will tip the beam A and close the circuit. By a little experimentation it will be found possible to have a small hole (about 1/64 inch dia.) in the bottom of the catch basin, so that when full it can slowly leak out, thus automatically resetting itself for the next rainstorm. The pan may be made removable to facilitate emptying it.

Contributed by SHELDON DAVIS.

SHOCKING MACHINE FROM ALARM CLOCK.

First take the alarm movement A from an old clock and arrange it as shown in the illustration. When the alarm is wound up the hammer moves back and forth between contact points H, thus breaking the circuit. Obtain a piece of board about 6 by 5 inches for the base and fasten the alarm down with screws. Then bend a copper wire around binding post J and back to within 1/16 inch of the hammer. For a pair of handles use two copper or brass tubes I I, about four inches long and two pieces of flexible wire about 18 inches long. Solder one end of each wire to the copper tubes and join the other end to the binding posts, as illustrated. A bell



Alarm Clock Escapement Utilized to Make and Break Shocking Circuit Thru a Coil F.

coil or sounder electro-magnet is connected in series with the battery. This apparatus can be used as a medical coil. A rheostat can be employed if desired. Contributed by VERNON APELGRAIN.

Experimental Chemistry

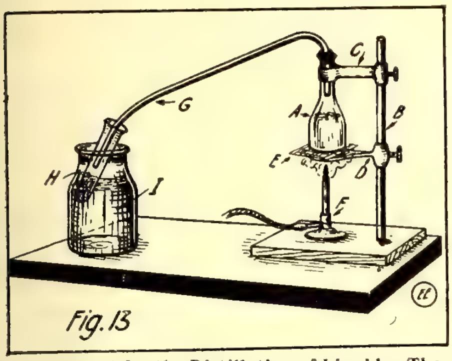
By Albert W. Wilsdon

Fourth Lesson

DISTILLATION.

TO make the delivery tubes to be used in the following experiments, refer to the June issue of THE ELECTRICAL EXPERIMENTER, under *Bending Glass Tube*, on page 110.

Bend a piece of glass tubing about 24



Arrangement for the Distillation of Liquids. The Vapor Is Condensed in "Cooled" Test Tube at Left.

inches long as shown in Fig. 15 "A" or "B" if it is to be used with a Florence flask; if to be used with a test tube, bend as shown in either "C" or "D."

The glass tubing should be about 24 inches long and each bend about 4 inches. Make true bends, and do not have the tube all kinked up. Fig. 16 "A" shows an incorrect bend which should never be used; "B" shows a properly bent glass tube.

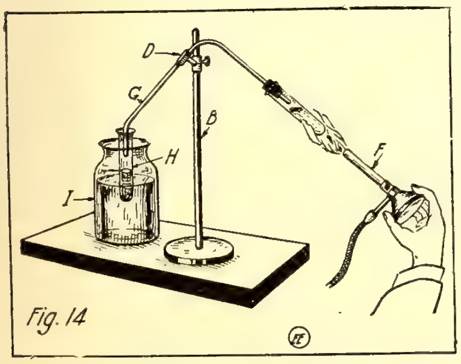
Water may be purified by means of distillation. This consists in boiling the water, as we shall do in Exp. No. 10, and then condensing the vapor in a cold receiver, standing in cold water or ice.

The principle of distillation lies in the fact, that at 100° Centigrade, or 212° Fahrenheit, water is converted into steam. Mineral matter, such as magnesium, iron, and so forth, which are the chief ingredients found in impure water, will be found to vaporize at a higher temperature than that of water, namely, 100° C. or 212° Fahr.; therefore the steam, when passed into a cold tube, condenses to form water, which is practically pure. Distilled water is not, however, absolutely pure, as there are traces of mineral matter (as well as gases which are absorbed from the air) contained in it.

Distillation is sometimes used on board ships, to convert salt water, which is taken from the ocean, into fresh water, which is pure enough for drinking and cooking.

EXPERIMENT NO. 10—

Dissolve some Potassium Permanganate

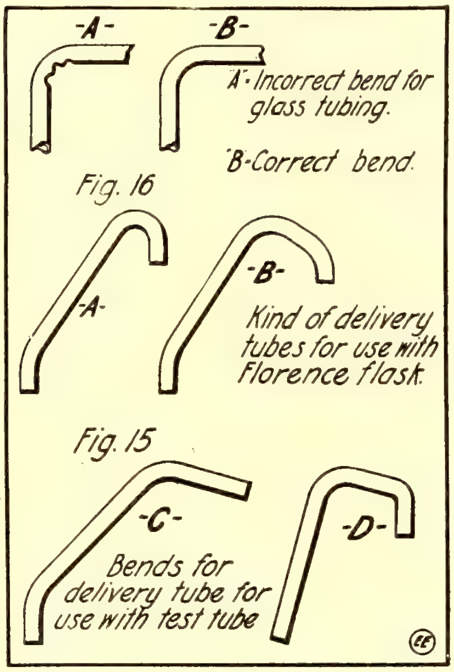


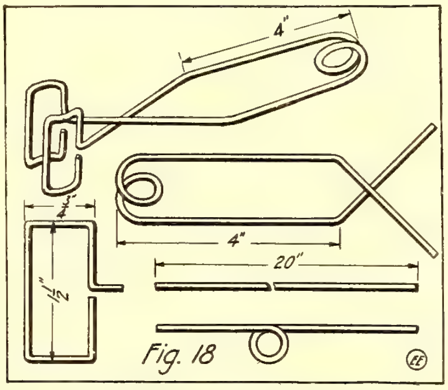
Method of Distillation by Means of Test Tube in Flame in Place of a "Florence" Flask.

in about 150 c.c. of water, which will produce a deep violet liquid, and put into a Florence flask of about 250 c.c. capacity, as shown in Fig. 13. If a test tube is employed to hold the liquid, use a large one, about 7 x 1 inch, and fill half full of water. Then dissolve the potassium permanganate in it.

In place of potassium permanganate copper sulphate or red ink, may be used; in fact anything which will color the water which is to be distilled in the test tube, so that the *distillate* and the *original liquid* may be compared.

Place the flask on a piece of wire gauze on the large support of a ring stand, and set up the balance of the apparatus as shown in Fig. 13. Next apply the heat of a Bunsen burner, being careful not to boil the liquid too rapidly. If you should boil the liquid too vigorously, remove the





Above: Various Shapes of Glass Tubing with Correct and Incorrect Bends. Below: Simple Test Tube Holder Made of Heavy Wire, Bent as Shown.

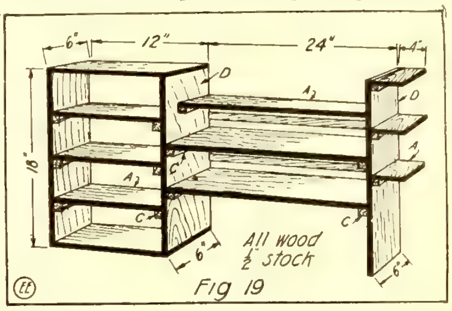
burner, and, if any of the liquid in the flask should pass over the delivery tube, into the test tube, throw away the water in the test tube, and commence over again, after cleaning the entire apparatus. Continue the boiling until you have collected about 20 c.c. of the condensed steam (the distillate) in the test tube H.

EXPERIMENT NO. 11—

Pour about 5 or 10 c.c. of the distillate (the water you collected in test tube H in Exp. 10) in two clean test tubes.

In one of these tubes allow a drop of phenolphthalein solution to mix with the pure water. You will notice that a clouded white solution has formed.

Into the other test tube put 1 drop of either ammonium hydroxide (NH_4OH) or ammonia water, and shake thoroughly. Now add 1 drop of the phenolphthalein



Useful Glass-ware and Chemical Rack, for Mounting at Back of Work Table.

solution to this mixture. Record your results.

Upon adding the phenolphthalein solution to the water containing the ammonia, a light cherry-red solution should be formed. This is a very delicate test for the presence of ammonia in water.

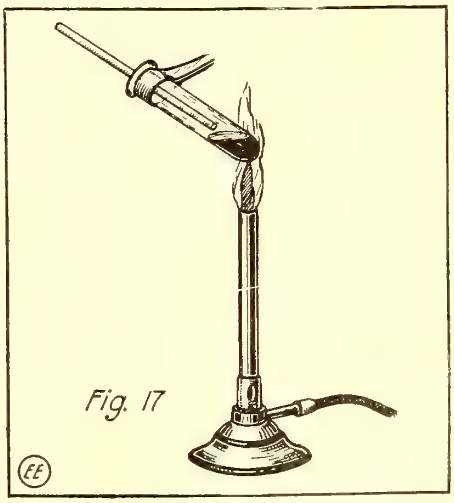
SUBLIMATION.

EXPERIMENT NO. 12—

Put 3 or 4 crystals of iodine into a wide, perfectly dry test tube. Have a dry stirring rod in the right hand, and with the left hand hold the tube containing the iodine in the flame of a Bunsen burner. As soon as dense purple fumes begin to rise in the tube, remove the tube from the flame and thrust the stirring rod into the tube, see Fig. 17, nearly to the bottom, being careful not to touch the sides of the tube with the rod. Keep it there until the iodine vapor is settled, and examine both tube and rod by means of a lens.

It will be noticed that when the rod was thrust into the dense violet vapor, this vapor *disappeared* after a short time, and when the rod was withdrawn, a finely powdered coating appeared on the lower part, which was not there before being lowered into the tube. It will also be noticed that a finely powdered coating has formed in the tube about one inch from the bottom. To sum this change up, we started with a large crystal, and, by applying heat to this

(*Continued on page 377*)



Experiment in "Sublimation" of Iodine. Similar to Action Occurring in "Distillation."

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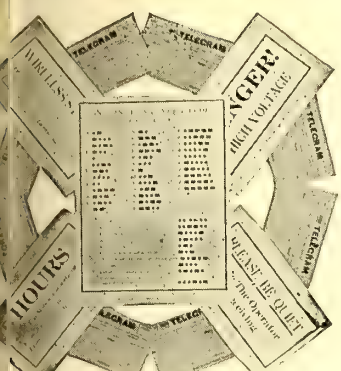

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Electro=set ·lineral Assortment

·· the convenience of our patrons · have put up a neat little assort-·nt of our Triple "A" grade min-·ls, comprising a selection of five ·erent kinds, each mineral packed ·l labeled, in a separate chemist's ·. We were the first company to ·k such a selection and the de-·nd for these little sets has been ·azing.

·enerous size crystal of each min-·l is furnished. The selection ena-·s the amateur to experiment and ·understand the characteristics of · various minerals used today in ·eless telegraphy. We heartily ·ommend the purchase of our ·nplete detector outfit, described ·ewhere in this issue. However, · those who are already supplied ·th sufficient apparatus, our min-·l assortment will prove a splen-·l buy. Every crystal is our ·ndard AAA grade, recognized ·erywhere as the highest grade ·nerals.

·e outfit comprises the following: ·e crystal each of Galena, Silicon, ·rborundum, Molybdenite, Iron ·rites or Ferron. FREE, with ·ch outfit, 1 foot phosphor bronze ·t-whisker wire.

·o. 2150 Mineral Assortment, 50 cents

(Postage extra, 5 cents)

Electro=Set Standardized Wireless MINERALS Famous the World Over

These testimonials should convince you to always insist on our signature on your minerals.

Read What They Say

Brooklyn, N. Y.
Gentlemen: I received your wireless minerals O. K. and will say that the Galena is the most sensitive mineral that has been my fortune to run across, and if used intelligently is a close second to the Audion.
1046 44th St. CLARENCE WEST.

Brooklyn, N. Y.
Gentlemen: I have found your Galena to be superior to any other mineral and I have recommended same to all my radio friends.
444 7th Ave. ELMER BAIER.

Atlanta, Ga.
Dear Sirs: The NAA Tested Galena received and the piece is fine.
221 E. 10th St. ALAN WHITTAKER, JR.

Waterville, Me.
Gentlemen: The last two pieces of Galena I bought of you were the best I ever saw.
160 College Ave. HAROLD M. CLAFLIN.

Vandergrift, Pa.
Dear Sirs: Received your Galena and found it to be great. I never had better Galena.
176 Grant Ave. A. L. VAN TINE.

Guarantee!

We guarantee Electro-Set Minerals, unqualifiedly, to be the most sensitive you can buy at any price and will gladly replace any minerals without question that do not *satisfy* in every particular.

We furnish two separate and distinct grades of minerals: "NAA." Individually Tested Crystals and "AAA" Bulk, Untested Minerals. Send today for a selection of these wonderfully sensitive wireless minerals.

Price List of Arlington Tested Grade
"NAA" MINERALS

NAA GALENA, individually packed and tested, per crystal	$0.25
NAA SILICON, individually packed and tested, per crystal	.25
NAA ZINCITE COUPLE, individually packed and tested, per set	.50

Price List of Triple "A" Grade
"AAA" MINERALS

Name of Mineral	Per 1 oz. Box	Per 4 oz. Box	Name of Mineral	Per 1 oz. Box	Per 4 oz. box
GALENA	$0.30	$1.00	IRON PYRITES	.30	1.00
SILICON	.30	1.00	COPPER PYRITES	.30	1.00
CARBORUNDUM	.30	1.00	BORNITE	.35	1.25
MOLYBDENUM per ½ oz.	.25	1.25			
ZINCITE	Per ½ oz. .40	Per 1 oz. 1.25			

·end 10c For Our Big Handy Book

SEE OPPOSITE PAGE

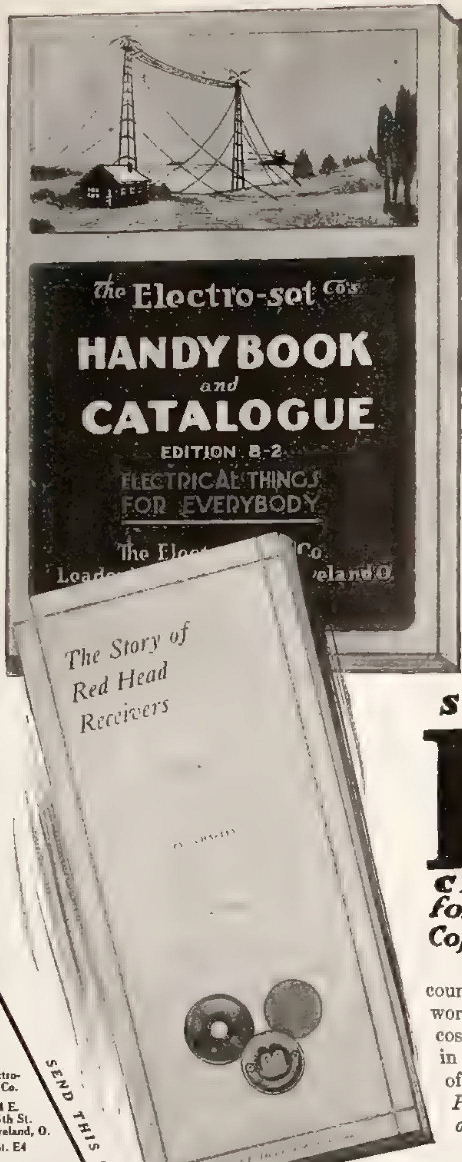
·PT. E-4
·74 E. 6th STREET
·EVELAND, OHIO

The Electro-set Co.

DEPT. E-4
1874 E. 6th STREET
CLEVELAND, OHIO

Every Experimenter

Must have these Two Books



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And Experimental Supplies

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A Few of the Interesting Items you will find the Handy Book

Treatise on Wireless Telegraphy	How to Calculate Capacities
Treatise on Tuning	Formulae for Capacities and Sp Lengths
Treatise on Simple Electric Measurements	Code Charts
Treatise on A B C of Electricity with many fascinating experiments	Tables of Transmitting Range
	" " Spark Voltages
	" " Inductivity
Treatise on Construction of Aerials	" " Weights and Measure
Care and Treatment of Minerals and Detectors	" " Wave Lengths
	" " Specific Gravity
Hook-ups—most approved for amateur use	" " Resistance
	" " Wire Data
How to make Selenium Cells	" " Winding Data
How to Calculate Wave Lengths	" " Spark Coil Constructs

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Wireless Telegraph Goods	Raw Materials
Motors	Parts
Electrical Toys	Telegraph Goods
Railways	Novelties
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—all at lowest prices and all the best of their kind.

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The Big Handy Book and Catalogue

contains more information than any twenty-f cent book now published—and besides descri countless interesting items which we ship by mail to every corner of t world. This book costs us $9,000 to compile and each individual c costs us 16 cents. We ask therefore that the trifling fee of 10 ce in stamps or money accompany your application to partly cover the c of postage and handling and as a mark of your good faith and inte *Positively no HANDY BOOK sent unless 10c accompany request.* O *one* HANDY BOOK sent to any one address.

The Story of "Red Head Receivers"

When you send for our Handy Book and Catalogue you will also rece without additional charge, a copy of our interesting booklet, "The Story of Red He Receivers," telling you about the finest wireless telegraph receivers made—excluding none—and exp ing just how we determined to make the best receivers in the world—and how we accomplished purpose. This booklet also explains how you can try "Red Head Receivers" at our expense for days—test them beside any other receiver made—and return them and get your money back every feature we claim for them isn't true.

SEND THIS COUPON NOW

The Electro-Set Co.
1874 E. 6th St.
Cleveland, O.
Dept. E4

Gentlemen:
Herewith please find enclosed 10c. in stamps or coin for which please send me by return mail your big Handy Book and Catalogue as per your offer in the ELECTRICAL EXPERIMENTER

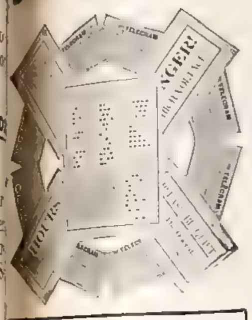
Name ....

Street ....

City and State..............
(Write plainly)

GET YOUR TWO BOOKS NOW

Fill in the attached coupon **today**—mail it **today.** Don't be without this most valu Handy Book and Catalogue another day. Every experimenter in the country needs it.



Something New for Your Wireless Station!

Four Fine Printed Placards
One Large Code Chart
One Pad Radio Blanks
All for 25c. Prepaid

Make your Wireless Station Business-Like and Up-to-date.

Send us twenty-five cents in stamps or coin for this big offer of needed printed matter for your wireless station It's the greatest value you ever bought We get it out as an advertising stunt—no profit for us—just to let you KNOW us

Here's what you get Four HANDSOME PRINTED SIGNS, as illustrated, to hang in your station, each printed on heavy bristol board, size 4 x 8 inches One LARGE CLEAR CODE CHART, with Morse and Continental Code, symbols and abbreviations Size 8 x 12 inches. One PAD RADIO TELEGRAPH BLANKS, as shown Very useful and novel. Size 3 x 5 inches

Every wireless experimenter needs this outfit. Send 25 cents today! We prepay postage. Extra pads of radio blanks 10 cents prepaid.

Electro=set Mineral Assortment

For the convenience of our patrons we have put up a neat little assortment of our Triple "A" grade minerals, comprising a selection of five different kinds, each mineral packed and labeled, in a separate chemist's box. We were the first company to pack such a selection and the demand for these little sets has been amazing.

A generous size crystal of each mineral is furnished. The selection enables the amateur to experiment and to understand the characteristics of the various minerals used today in wireless telegraphy. We heartily recommend the purchase of our complete detector outfit, described elsewhere in this issue. However, for those who are already supplied with sufficient apparatus, our mineral assortment will prove a splendid buy. Every crystal is our standard AAA grade, recognized everywhere as the highest grade minerals.

The outfit comprises the following: one crystal each of Galena, Silicon, Carborundum, Molybdenite, Iron Pyrites or Ferron. FREE, with each outfit, 1 foot phosphor bronze cat-whisker wire.

No. 2150 Mineral Assortment, 50 cents

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NAA GALENA, individually packed and tested, per crystal....................$0.25
NAA SILICON, individually packed and tested, per crystal.................... .25
NAA ZINCITE COUPLE, individually packed and tested, per set.................... .50

Price List of Triple "A" Grade
"AAA" MINERALS

Name of Mineral	Per 1 oz. Box	Per 4 oz. Box	Name of Mineral	Per 1 oz. Box	Per 4 oz. box
GALENA..............	$0.30	$1.00	IRON PYRITES.......	.30	1.00
SILICON..............	.30	1.00	COPPER PYRITES....	.30	1.00
CARBORUNDUM.....	.30	1.00	BORNITE.............	.35	1.25
MOLYBDENUM per ½ oz.	.25	1.25			
ZINCITE.................................Per ½ oz. .40					Per 1 oz. 1.25

Send 10c For Our Big Handy Book

SEE OPPOSITE PAGE

DEPT. E-4
1874 E. 6th STREET
CLEVELAND, OHIO

The Electro-set Co.

DEPT. E-4
1874 E. 6th STREET
CLEVELAND, OHIO

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK, UNTIL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of February, 1916. (Continued.)

SIXTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
6HO	Ardenyi, Wm. A.	41 Greenbank Ave., Piedmont, Cal.	.5
6OV	Atkins, Carl	145 N. Hancock St., Los Angeles, Cal.	1
6RB	Barbagelata, Russell	604 42d St., Oakland, Cal.	..
6EE	Billhimer, Samuel J.	Colfax, Cal.	.5
6GR	Brown, Clarence C.	1038 Balboa St., San Francisco, Cal.	.5
6FM	Carroll, Russell W.	354 Perry St., Oakland, Cal.	.5
6HE	Castro, Morris	232 Lexington Ave., Rust, Cal.	.5
6KM	Dalby, Wm.	2907 Hillegass Ave., Berkeley, Cal.	1
6LK	Diamond, Ray	Piedmont Park, Oakland, Cal.	1
6TB	Dietz, Irwin C.	136 S. Griffin Ave., Los Angeles, Cal.	.5
6NK	Duncan, Harold	131 W. Jefferson St., Los Angeles, Cal.	.5
6TH	Fabian, Ernest	1368 20th Ave., San Francisco, Cal.	.5
6PE	Fleming, Robert P.	606 San Benito St., Los Angeles, Cal.	.5
6OD	Foster, Lewis K.	3452 16th St., San Francisco, Cal.	.5
6RM	Gabriel, Edward J.	657 Guerrero St., San Francisco, Cal.	.5
6NC	Gould, William S.	560 D St., San Rafael, Cal.	.5
6AI	Green, Alfred	221 E. Anderson St., Stockton, Cal.	.5
6ME	Gregory, Marshall	554 5th St., San Diego, Cal.	.5
6SL	Hart, Cedric E.	718 6th Ave., Salt Lake City, Utah.	1
6UI	Helmer, Glenn	343 N. Comstock Ave., Whittier, Cal.	.5
6CI	Hillen, Russell W.	162 W. Alvarado St., Pomona, Cal.	.5
6HB	Hunt, Homer G.	1740 96th Ave., Oakland, Cal.	1
6FC	Isham, Carlton	1323 96th Ave., Oakland, Cal.	.5
6KF	Jackson, Milton S.	833 17th St., San Diego, Cal.	.5
6GS	Johnson, Philip	475 California St., Pasadena, Cal.	.5
6GV	Jones, Alfred H.	962 D Ave., Coronado, Cal.	.5
6KI	Jones, Ernest P.	R. F. D., Auburn, Cal.	.5
6GX	Long, Herman D.	402 N. New 18th St., San Jose, Cal.	.5
6SJ	Lopez, John	1645 S. New Hampshire St., Los Angeles, Cal.	.5
6SE	Lynde, Laurence F.	Huntington Drive, Los Angeles, Cal.	.5
6MS	McArdle, James J.	263 Day St., San Francisco, Cal.	.5
6EZ	McHolland, Raymond	2800 Oregon St., Los Angeles, Cal.	1
6SH	Macquarrie, Harold C.	405 E. Fremont St., Stockton, Cal.	1
6GG	Malarin, Henry J.	719 Page St., San Francisco, Cal.	.5
6WD	Martinelli, Ennis	953 Mission Ave., San Rafael, Cal.	.5
6JE	Mead, John H.	7231 Hollywood Blvd., Los Angeles, Cal.	.5
6JW	Meyer, Joseph U.	804 40th St., Oakland, Cal.	.5
6EU	Michelson, Melvin O.	530 Franklin St., Napa, Cal.	.5
6WB	Moller, Wm., Jr.	426 29th St., Oakland, Cal.	.5
6MA	Montgomery, Alvin R.	2303 Pacific Ave., Alameda, Cal.	1
6IW	Muller, Lloyd	832 Haight St., San Francisco, Cal.	.5
6PB	Pagh, Val E.	Randsburg, Cal.	.5
6MP	Parsons, Wm.	2921 Manitou Ave., Los Angeles, Cal.	.5
6WI	Powell, Joseph F.	1125 N. Wilson Ave., Pasadena, Cal.	1
6CH	Raley, Mannie L.	Lordsburg, Cal.	.5
6SP	Rathbun, Theodore B.	1202 S. Normandie Ave., Los Angeles, Cal.	.5
6GJ	Richardson, Charles E., Jr.	406 W. 28th St., Los Angeles, Cal.	1
6GB	Roberts, Edwin D.	Los Altos, Cal.	.5
6FB	Rutherford, Paul H.	431 San Francisco Ave., Pomona, Cal.	1
6NL	Sawyer, Clifford D.	47 Washington St., Reno, Nev.	.5
6IO	Shaffer, John	846 E. 33d St., Los Angeles, Cal.	.5
6AZ	Springman, Arthur E.	1818 N. Broadway, Los Angeles, Cal.	1
6DD	Stagi, Guadenzio	Los Altos, Cal.	.5
6RH	Stamback, Rollo L.	753 Redondo Ave., Long Beach, Cal.	.5
6RP	Stonecipher, Charles E.	7227 S. Moneta Ave., Los Angeles, Cal.	.5
6HP	Stonehocker, Harold	1732 Webster Ave., Fresno, Cal.	.5
6SG	Themer, Francis	1536 F St., San Diego, Cal.	.5
6NE	Thompson, Lloyd	239 E. Whiting Ave., Fullerton, Cal.	1
6HT	Walters, Wm. T.	2140 Tyler Ave., Fresno, Cal.	.5
6KW	Warriner, Willard V.	245 Eagle Rock Ave., Los Angeles, Cal.	1
6EY	Watson, Edwin A.	1611 Walnut St., Alameda, Cal.	.5
6FE	Wickersham, Harry H.	149 San Carlos Ave., San Francisco, Cal.	.5
6NB	Winter, Gilbert H.	1742 Bushnell Pl., Berkeley, Cal.	.5
6RT	Wright, Harry E.	935 Harrison St., Oakland, Cal.	.5

SEVENTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
7HE	Carroll, Thomas M.	1913 E. Alder St., Seattle, Wash.	.5
7WC	Cates, Walter C.	1704 Franklin St., Vancouver Wash.	1
7DQ	Drinker, Russell	1003 Lynn Ave., Portland, Oreg.	.5
7FI	Fraser, James E.	1105 West A St., North Yakima, Wash.	.5
7EE	Hawkins, Edward K.	1800 27th Ave., South, Seattle, Wash.	.5
7JH	Hurtt, John N.	1067 E. Burnside St., Portland, Oreg.	.5
7MJ	Mead, Walter J.	Nehalem, Oreg.	1
7SN	Norman, Stacy W.	137 79th St., Seattle, Wash.	.5
7PO	Poole, Orell A.	Wallowa, Oreg.	.5
7GQ	Reeder, Ardis H.	412 South K St., Tacoma, Wash.	.5
7RF	Ryberg, Roy E.	525 Federal Ave., Seattle, Wash.	.5
7DH	Tennican, Leonard S.	4016 Colby Ave., Everett, Wash.	1
7FP	Trumbull, Wm. L.	365 McGrew St., Seattle, Wash.	1
7LF	White, Lester T.	1090 Water St., Portland, Oreg.	.5
7JW	Wilson, John C.	295 N. 24th St., Portland, Oreg.	1

EIGHTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
8AOR	Adams, Joy C.	48 N. Wabash Ave., Battle Creek, Mich.	1
8TX	Anders, Harry R.	Decatur, Mich.	.5
8AAB	Anderson, L. R.	Youngstown, Ohio.	.5
8APM	Auten, George C.	Oberlin, O.	1
8APK	Bachtel, Alfred	Akron, O.	.5

EIGHTH DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
8AAW	Baer, Walter D.	350 Graham St., Pittsburgh, Pa.	1
8FW	Banes, Charles C. A.	143 Chess St., Monongahela City, Pa.	.5
8APA	Beer, Frank P.	514 Jarvella St., Pittsburgh, Pa.	1
8AAO	Bishman, Richard F.	67 Foster Ave., Norwalk, O.	.5
8APN	Bock, Ashley P.	1112 W. North St., Kalamazoo, Mich.	1 1
8AAS	Bower, Geo. C.	Blasdell, N. Y.	.5
8AOP	Bowyer, Glenn B.	Kinsman, O.	.5
8AOK	Brewster, Fred J.	6904 Cedar Ave., Cleveland, O.	.5
8FR	Briggs, Fred G.	221 Forest St., Marion, O.	.5
8ADP	Brown, Clarence W.	R. F. D. No. 25, Akron, O.	.5
8WZ	Brown, Ralph M.	156 W. River St., Wilkesbarre, Pa.	1
8ABA	Burgwardt, Fred. C., Jr.	R. F. D. No. 2, Hamburg, N. Y.	.5
8TA	Burson, John I.	238 W. Wood St., Youngstown, O.	.5
8WR	Carter, David G.	Grosse Pointe, Mich.	.5
8PW	Case, Theodore J.	1609 S. University Ave., Ann Arbor, Mich.	.5
8API	Childs, Herbert R.	12 Bengel Ter., Rochester, N. Y.	.5
8AOH	Clauve, Carl H.	435 Shillito St., Cincinnati, O.	.5
8AOW	Clem, Robert	605 N. Jameson St. Lima, O.	.5
8SL	Cocklin, Gilbert W.	Middlebranch, O.	.5
8ABS	Colville, Perkins	514 E. Buffalo St., Ithaca, N. Y.	1
8AOX	Cooley, Clair R.	298 Walbridge Ave., Toledo, O.	.5
8WV	Corts, Ray E.	243 May St., Buffalo, N. Y.	.5
8AOV	Cramer, Charles F.	115 N. Fountain St., Springfield, O.	1
8AOG	Creps, John A.	1431 Lakewood Ave. Lima, O.	.5
8ADI	Cundall, Lincoln A.	Hamburg, N. Y.	.5
8AOI	Curtiss, Gerald H.	624 9th St., Traverse City, Mich.	1
8AAQ	Devinney, Robert C.	1224 Boyle St., Pittsburgh, Pa.	1
8AOT	Demarest, Foster J.	103 Washington St., Williamsport, Pa.	1
8AOA	Dieter, Howard L.	253 S. 18th St., Columbus, O.	1
8AQD	Dilworth, John G.	6121 Jackson St., Pittsburgh, Pa.	.5
8AOJ	Durstine, John E.	107 Burton Ave., Cleveland, O.	.5
8AOS	Eiszler, Emmerson L.	1227 California Ave., Pittsburgh, Pa.	.5
8AOZ	Ferris, James H.	211 Catalpa Drive, Royal Oak, Mich	1
8FV	Francis, Jesse J.	1556 E. 66th St., Cleveland, O.	.5
8AAV	Frank, Newton J.	411 Humboldt Pky, Buffalo, N. Y.	.5
8ABE	Gottschalt, Robert	102 Burton Ave., Cleveland, O.	1
8WA	Griffin, Jesse W.	Middlefield, O.	.5
8AOM	Hamel, Arthur	29 Martin Ave., Amherst, O.	1
8AMI	Hanny, George	1716 Buena Vista St., Pittsburgh, Pa.	.5
8AA	Hausdign, Wm. A.	Traverse City, Mich.	.5
8APG	Henes, Christian	604 Main St., Hamilton, O.	1
8AMP	Hodgkins, Harley G.	Massena, N. Y.	.5
8GT	Hoover, Raymond	Maumee, O.	.5
8ABR	Howe, Richard H.	Granville, O.	.5
8FL	Hudson, Albert N.	406 Park Ave., Fulton, N. Y.	.5
8APR	Huff, Samuel W.	915 Campbell St., Williamsport, Pa.	.5
8AOY	Hughes, Edwin R.	20 74th St., Carthage, O.	.5
8AOE	Hull, James E.	329 Main St., Cheboygan, Mich.	1
8NK	Hunt, Barton L.	1280 Courtland Ave., Columbus, O.	.5
8ABN	Jones, Hugo W.	109 Marshall St., Conneaut, O.	.5
8WF	Judd, Max A.	Chesaning, Mich.	.5
8AOC	Kent, Arthur L.	199 Court St., Binghamton, N. Y.	.5
8AQE	Kerstetter, J. Howard	633 Carlton St., Toledo, O.	.5
8AQA	King, Wm. R.	6920 Wellesley Ave., Pittsburgh, Pa.	1
8QF	Kirchner, Charles	425 Cumberland Ave., Buffalo, N. Y.	.5
8ADJ	Kohli, Homer J.	Pandora, O.	1
8MM	Levy, Irving R.	1333 E. Blvd., Cleveland, O.	1
8RH	Locke, Carl M.	1500 Coutant St., Lakewood, O.	1
8APE	Lockwood, Harry P.	312 Huron St., South Haven, Mich.	.5
8IK	McDowell, M. Fay	612 Mithoff St., Columbus, O.	1
8AOU	McKee, Robert R.	7008 Church Ave., Ben Avon, Pa.	1
8LM	MacLaughlin, Donald	261 W. 8th St., Marysville, O.	1
8AKJ	Merrick, W. Bernard	156 Marshall St., Conneaut, O.	.5
8UL	Mitchell, Phillip	8806 Blaine Ave., Cleveland, O.	.5
8UZ	Moore, John B.	141 Park St., Buffalo, N. Y.	.5
8AOF	Morrow, Lorentz A.	1231 E. High St., Springfield, O.	1
8SR	Mueller, Henry C.	1919 Doll St., Pittsburgh, Pa.	.5
8AAM	Murdoch, Wm. B., Jr.	301 W. College St., Canonsburg, Pa.	.5
8ANZ	Murray, Charles J.	701 W. Fair St., New Philadelphia, O.	.5
8EN	Myers, George E.	R. F. D. No. 1, Grand Blanc, Mich.	.5
8APT	Newton, Harold D.	565 School St., South Haven, Mich.	.5
8ADQ	Olson, Elvin E.	Frankfort, Mich.	.5
8AMK	Perry. Paul A.	136 Woodbine Ave., Rochester, N. Y.	.5
8CJ	Plantinga, John G.	10321 Ashbury Ave., Cleveland, O.	1
8RU	Poad, Edwin H.	1509 E. 123d St., Cleveland, O.	.5
8AOD	Ragsdale, Charles C. C.	146 S. Bryant Ave., Bellevue, Pa.	1
8LS	Rawson, Myron A.	535 Lodi St., Elyria, O.	.5
8APW	Reichle, Henry W.	Morrison and Cleveland Aves., Pittsburgh, Pa.	.5
8APG	Richardson, Norton	70 Davenport St., Detroit, Mich.	.5
8AOO	Sauerbrey, Wm. J.	Shenandoah, Pa.	.5
8AOQ	Saunders, Ezra L.	141 4th Ave., Gallipolis, O.	1
8APD	Schmidt, Paul	106 Excelsior St., Pittsburgh, Pa.	.5
8APU	Servais, Francis W.	Falls Creek, Pa.	1
8TE	Shafer, Andrew L.	Scott, O.	.5
8KZ	Snyder, Lawrence L.	260 S. Walnut St., Ravenna, O.	1
8ABK	Storck, Howard J. C.	694 Carpenter St., Columbus, O.	.5
8TO	Stotter, Herbert J.	1397 E. Blvd., Cleveland, O.	1
8AK	Taylor, Willard L.	148 Kennedy St., Syracuse, N. Y.	1
8SZ	Tobin, W. A.	426 W. McKibben St., Lima, O.	1
8APO	Twitchell, H.	4th and Wood Sts., Hamilton, O.	1
8QT	Van Buren, Harold J.	114 N. Crawford Ave., New Castle, Pa.	1
8OB	Wachs, Wm. C.	235 Hosea Ave., Cincinnati, O.	.5
8EJ	Watson, Samuel C.	Wilberforce, O.	1
8EY	Weaver, J. Marshall	208 N. Main St., Greensburg, Pa.	.5
8JJ	Weber, Walter B.	660 Riley St., Buffalo, N. Y.	1
8TM	Do.	791 Seneca St., Buffalo, N. Y. (has 2 stations)	1

(Continued on opposite page)

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK, UNTIL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of February, 1916 (Continued).

EIGHTH DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
8TF	Welch, Thomas E	92 N. Main St., Mechanicsville, N. Y.	1
8APS	Welty, Noble K	302 W. College St., Canonsburg, Pa.	.5
8ACS	Wiley, Donald A	3029 Harvey Ave., Cincinnati, O.	.5
8VK	Willard, Charles A	2025 W. 95th St., Cleveland, O.	.5
8KT	Williamson, Warren, Jr.	1840 Market St., Youngstown, O.	.5
8GC	Wilson, Albert S	Apollo, Pa.	1
8AOL	Wood, Walter S	752 Ardmore St., Akron, O.	.5
8AON	Worden, Ralph P	665 Lafayette Rd., Medina, O.	.5
8AI	Wright, Wm. A. S	7216 McCurdy Pl., Ben Avon, Pa.	.5
8VV	Zeigler, Harry W	7th and Ross Sts., Tarentum, Pa.	1

NINTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
9DI	Ahrensfeld, Wm. H	200 N. Prospect Ave., Park Ridge, Ill.	.5
9ACI	Allen, George M	435 Lane St., Topeka, Kans.	.5
9HZ	Anderson, Ivan H	1711 11th Ave., South Minneapolis, Minn.	.5
9MP	Anderson, Paul D	Lamoni, Iowa	1
9ABR	Baker, Warren C	38 E. Madison St., Tipton, Ind.	1
9EM	Ball, George W	6601 Olmsted Ave., Chicago, Ill.	1
9EJ	Barnett, Lawrence T	684 Greenleaf Ave., Glencoe, Ill.	.5
9ADL	Bates, Clarence	2015 Wells St., Milwaukee, Wis.	1
9AAU	Blasier, Herbert, Jr	Williamsburg, Iowa	1
9CP	Brauch, Nicholas	515 Court St., Le Mars, Iowa	1
9LD	Brooks, Ralph	27 156th Pl., West Hammond, Ill.	1
9ADO	Bullock, Merlin and Gerald	3600 Gladstone Blvd., Kansas City, Mo.	1
9ABE	Button, Bert A	2850 R St., Lincoln, Neb.	1
9ADH	Clark, Donald L	3240 Alcott St., Denver, Colo.	.5
9ABD	Corwin, Willis	117 E. McCarty St., Jefferson City, Mo.	.5
9NF	Cottrell, Wm. R	Prairie City, Iowa	1
9ABA	Crabb, Thomas G	5906 Cater Ave., St. Louis, Mo.	1
9ACN	Curry, Wilfred N	Sweet Springs, Mo.	.5
9KZ	Davis, Wm. R	1409 W. Edwards St., Springfield, Ill.	.5
9ACT	Degner, Le Roy	394 24th Ave., Milwaukee, Wis.	1
9DX	Deich, Dayton, P	Limon, Colo.	.5
9ABN	Deming, Herschel	1545 Barth Ave., Indianapolis, Ind.	.5
9ACA	Doerfler, Hilary	Collegeville, Minn.	.5
9ACG	Duncan, Wilbur H	1199 W. Wood St., Decatur, Ill.	.5
9BA	Elmore, Virtus R	615 N. Madison St., Marion, Ill.	1
9ADC	Erickson, Einer A	225 Lafayette Ave., Racine, Wis.	.5
9ABT	Fedder, Herman	1440 W. High St., Davenport, Iowa.	.5
9ACR	Frank, George	1727 W. 2d St., Davenport, Iowa.	.5
9ADA	Franklin, Maurice W	Seward, Neb.	1
9EU	Frech, Lester	336 E. Sutterfield St., Fort Wayne, Ind.	.5
9ABS	Frenzel, Oscar F., Jr	1338 N. New Jersey St., Indianapolis, Ind.	.5
9MK	Giddings, Edward H	Lanark, Ill.	.5
9JN	Glasgow, Roy S	3966 Arsenal St., St. Louis, Mo.	1
9ACS	Gooch, Bertram	703 Marion St., Boone, Iowa	1
9KF	Goorisich, John A	2316 Clybourn St., Chicago, Ill.	.5
9LY	Greene, Clark W	1113 Park Row, Lake Geneva, Wis.	.5
9ACD	Greene, John	Prairie du Chien, Wis.	.5
9ADB	Greenwood, George W., Jr.	1321 Western Ave., Topeka, Kans.	.5
9DF	Hagedorn, Gilbert H	357 N. Pleasant St., Kenosha, Wis.	.5
9ACU	Hageman, Edwin S	Ellsworth, Wis.	.5
9AAY	Harris, Frank M., Jr	920 N. Harrison St., Topeka, Kans.	.5
9ADQ	Hecht, Royal H	1523 Estes Ave., Chicago, Ill.	1

NINTH DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
9CR	Heise, Paul A	841 Wilson Ave., Chicago, Ill.	1
9IL	Hellwig, Emil C	1729 Sunnyside Ave., Burlington, Iowa	.5
9ABI	Honecker, Walter	3106 Graceland Ave., Indianapolis, Ind.	.5
9MO	Huffman, Verne A	218 Jackson St., Polo, Ill.	.5
9ADG	Hughes, Arthur S	7390 Maple Ave., Maplewood, Mo.	1
9ADF	Jarboe, Owen	109 Locust St., Carrollton, Ill.	1
9ACM	Jeffrey, Albert E	High School, Goshe, Ind.	1
9ADE	Keller, Carl E	Kinsey, Kans.	.5
9AAT	Kenyon, Vernon N	Dunwoody School, Minneapolis, Minn.	1
9ABM	Kingsland, Le Roy	2326 Clarence Ave., St. Louis, Mo.	.5
9ADM	Le Vine, George L	801 W. 7th St., Des Moines, Iowa.	1
9AX	Loosen, Irving R	2609 Olive St., Kansas City, Mo.	1
9ADK	MacMillan, Charles W	635 Vine St., Denver, Colo.	.5
9ACK	McQuilkin, Joseph R	1815 N. 6th St., Sheboygan, Wis.	.5
9AG	Martens, Hugo	2015 Gaines St., Davenport, Iowa.	.5
9AAZ	Mathiasen, Carl A	Onawa, Iowa	.5
9MN	Maynard, P. Neff	208 W. 7th St., Boone, Iowa	1
9KG	Melcher, John M	Wautoma, Wis.	.5
9ADD	Meldru, George E	Carrollton, Ill.	.5
9KR	Miller, John F	670 Rush St., Chicago, Ill.	1
9FH	Millspaugh, Charles H., Jr.	317 S. Franklin St., Decatur, Ill.	.5
9AAV	Mole, Harry H	2853 Fowler Ave., Omaha, Neb.	.5
9EE	Mueller, Clarence	2421 N. Sawyer Ave., Chicago, Ill.	.5
9ABU	Myers, Wilford U	209 N. 3d St., Charleston, Mo.	.5
9ADJ	Nelson, Lee M	Seward, Neb.	1
9MG	Novak, Joe J	4031 S. Campbell Ave., Chicago, Ill.	.5
9AF	O'Connell, John B	6218 Ellis Ave., Chicago, Ill.	.5
9FB	Pearce, Wm. W., Jr	538 Steele Court, Waukegan, Ill.	.5
9KI	Petersen, Howard E	1424 E. 70th St., Chicago, Ill.	1
9NU	Perry, William N	825 Lake Ave., Racine, Wis.	.5
9ABW	Pfeiler, Lawrence	1810 N. 5th St., Sheboygan, Wis.	1
9ACW	Pfister, Walter	516 Erie Ave., Sheboygan, Wis.	.5
9GT	Pollard, Lynn	929 W. Governor St., Springfield, Ill.	.5
9KD	Rathert, Will P	316 W. 5th Ave., Cresco, Iowa	1
9ADI	Rufsvold, Arnold S	3216 16th Ave., South, Minneapolis Minn.	.5
9FI	Salisbury, Hubbard H	1703 Hanks Ave., Superior, Wis.	.5
9FC	Schulte, Herman	Oregon, Mo.	1
9AAX	Schulze, A. N	2864 Amos Ave., Omaha, Neb.	.5
9BY	Scoven, Paul	327 E. Park Ave., Kokomo, Ind.	.5
9ACE	Shanks, Charles E	2660 Sutton Ave., Maplewood, Mo.	1
9ABO	Shephard, Floyd P	936 Center St., Racine, Wis.	.5
9EY	Simms, Lincoln J	318 Locust St., Elgin, Ill.	1
9ABG	Smith, Noble	1329 Brook St., Louisville, Ky.	.5
9JK	Snyder, Wm. O	Sweet Springs, Mo.	.5
9LJ	Spencer, Alvin C	Magnolia, Ill.	1
9KP	Spencer, Levi	Gilman, Ill.	.5
9ADP	Stanley, Charles A	1415 N. Hillside Ave., Wichita, Kans.	1
9AM	Theisen, Peter J	3413 Meade St., Denver, Colo.	.5
9AAW	Todd, J. Richard	Louisville, Ill.	.5
9ABK	Todd, Leonard	2269-A Red Bud Ave., St. Louis, Mo.	.5
9BK	Trier, Paul W	803 2d Ave., Maywood, Ill.	.5
9EF	Vander Veer, Guy E	1246 W. Randolph St., Chicago, Ill.	.5
9FA	Walker, Lloyd A	1716 S. 20th St., St. Joseph, Mo.	.5
9AY	Ward, Lloyd S	1227 Chestnut St., Rockford, Ill.	1
9ACO	Wittick, Eugene C	104 6th Ave., Moline, Ill.	.5
9ADN	Wright, Kenneth E	855 Grand Ave., Waukegan, Ill.	.5

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of March, 1916.

FIRST DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
1EMI	Baker, J. Stannard	40 Sunset Ave., Amherst, Mass.	.5
1EMA	Bauer, Paul S	169 Lynn Shore Drive, Lynn, Mass.	1
1EAH	Berry, Gerald D	28 N. Central Ave., Wollaston, Mass.	.5
1KE	Blackie, Norman E	110 Norfolk St., Dorchester, Mass.	.5
1EAK	Blake, Wm. F	104 Rutherford Ave., Charlestown, Mass.	.5
1EMC	Bloom, Harry	682 2d St., Fall River, Mass.	.5
1EAP	Bowers, M. A	13 Belmont Ave., Camden, Me.	.5
1EAU	Bowers, Wm. K	6 Samoset St., Dorchester, Mass.	.5
1EAJ	Brassill, Jas. J	East Providence, R. I.	.5
1EIC	Chesbro, Everett L	54 High St., Mystic, Conn.	.5
1EMH	Copeland, Sylvester W	656 2d St., Fall River, Mass.	.5
1EAD	Courtney, Roger D	98 W. Springfield St., Boston, Mass.	.5
1EMV	Dean, J. Marshall	46 Alderman St., Springfield, Mass.	.5
1EMJ	De Lancey, Clyde P	Hampton, N. H.	.5
1EMD	De Lano, Ralph B	76 Hancock St., Stoneham, Mass.	.5
1EMK	Dock, Luther	59 Granite St., Westerly, R. I.	.5
1EAQ	Downes, Geo. H	323 Edgewood Ave., New Haven, Conn.	.5
1EIN	Eaton, Louis F	165 Belmont St., Brockton, Mass.	.5
1EIO	Estabrooks, Roland W	33 Parkland Ave., Lynn, Mass.	1
	Fall River State Armory	(See Norwell, Joseph C.)	
1EAT	Feeney, Paul F	80 Crest Ave., Revere, Mass.	.5
1EMZ	Fortier, Ralph L	248 Fort Pleasant Ave., Springfield, Mass.	.5
1EAZ	Furrier, Joseph P	19 Tudor St., Lynn, Mass.	.5
1EAC	Hardy, Ralph	19 Parkman St., Boston, Mass.	.5
1EIH	Heffernan, Edmund J	369 Main St., New Britain, Conn.	1
1EMQ	Heidel, Edward O	29 Hollister St., Pittsfield, Mass.	.5
1EIP	Hudder, Paul B	222 Eastern Ave., Gloucester, Mass.	.5
1EMT	Hoopes, Thomas T	118 High St., Newburyport, Mass.	.5
1EAR	Jacques, Arthur E	52 Newton St., Marlboro, Mass.	.5
1EIJ	Knight, Winfield W	105 Chestnut St., Camden, Me.	.5
1EAO	La Marche, Harold E	70 George St., Attleboro, Mass.	.5
1EIV	Lawyer, Lanphere R	27 Barnett St., New Britain, Conn.	.5
1EIE	Leidel, Ralph J	28½ Warren St., Providence, R. I.	5
1EIM	Lewis, Kenneth P	124 Maplewood Ave., Gloucester, Mass.	.5
1EIL	Loheed, Wm. J., Jr	12 Clifton Ave., Campello, Mass.	.5

FIRST DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
1EIY	Loomis, Geo. A	119 S. Main St., St. Albans, Vt.	.5
1EMB	Lovejoy, Julian	Littleton, Mass.	1
1EIX	Man, Edward H	North Stonington, Conn.	.5
1EAW	Marshall, Robert E	2 Pleasant Pl., Marlboro, Mass.	.5
1ENA	Martin, Paul S	79 7th St., Turners Falls, Mass.	1
1EAY	McCarthy, Geo. E	20 Belden St., New Britain, Conn.	.5
1EME	Morrison, Raymond D	17 Malbone Ave., Newport, R. I.	.5
1EIU	Murphy, Charles F	54 Essex St., Marlboro, Mass.	.5
1EAF	Norwell, Joseph C	Fall River, Mass.	.5
1EMP	Petrie, Andrew L	22 Lamberton St., New Haven, Conn.	.5
1EMG	Polleys, Wm. V., Jr	606 Public St., Providence, R. I.	.5
1EMR	Poole, Willard H	229 Belmont St., Fall River, Mass.	.5
1EAG	Reeves, Clarence E	37 Edgewood St., Roxbury, Mass.	.5
1EAM	Remington, Frederick H.	269 St. Botolph St., Boston, Mass.	.5
1EMU	Rogers, Harold A	39 Paulena St., West Somerville, Mass.	.5
1EML	Ryder, Malcolm P	86 Calhoun St., Springfield, Mass.	.5
1EIG	Sacs, Jas. G	124 Prairie Ave., Providence, R. I.	.5
1EMF	Stacy, Frank A	7 Dodge Court, Danvers, Mass.	.5
1EMN	Straub, Alphonse B	151 S. Elm St., Waterbury, Conn.	.5
1EAN	Swanton, Wm. A	42 Dix St., Dorchester, Mass.	.5
1EIK	Tarment, Ralph E	381 Main St., Everett, Mass.	.5
1EAV	Tatreault, Ernest	Northbridge, Mass.	.5
1EIQ	Taylor, Alfred C	788 Hope St., Providence, R. I.	.5
1EAS	Taylor, David F	55 Bromfield St., Wollaston, Mass.	.5
1EIA	Tobey, Harold A	42 Pomeworth St., Stoneham, Mass.	.5
1EIF	Towner, F. Bruce	133 Belmont St., Everett, Mass.	.5
1RIB	Walker, Leon F	45 Nixon St., Dorchester, Mass.	.5
1EII	Wallace, Malcolm E	6 Witherbee Ter., Marlboro, Mass.	.5
1EIW	Walter, Howard S	Melrose, Mass. (portable station)	.5
1EAL	Weeks, Walter R	47 Pleasant St., Marlboro, Mass.	1
1EMW	White, Elmir L., Jr	61 Shurtleff St., Chelsea, Mass.	.5
1EMX	Wiesemeyer, Max L. A.	Stonington, Conn.	.5
1EMY	Young, Frank A	525 W. Main St., Meriden, Conn.	.5

SECOND DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
2AMA	Ackerman, Rudolph W	Scarsdale, N. Y.	1
2ANL	Adams, Chester B	41 Osborn St., Keyport, N. J.	.5
2AMV	Adolph, Herbert	1167 Clay Ave., New York, N. Y.	.5

(To be continued)

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

RADIO SET OF HOWARD WHITE.

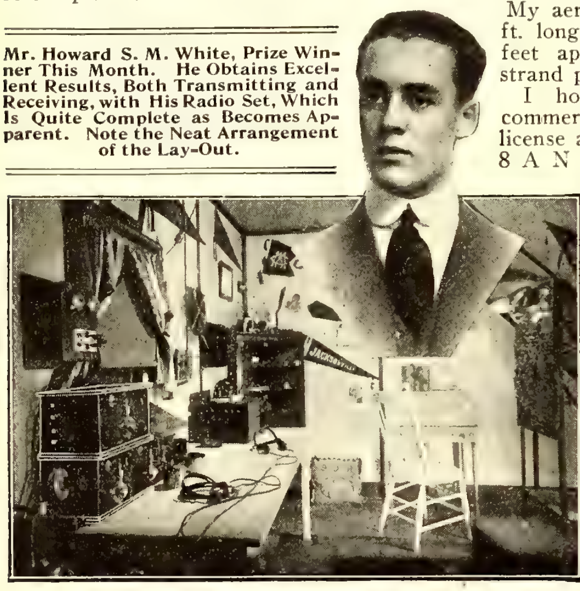
Herewith is a photograph of my sending and receiving station, which is described below:

My sending set comprises the following: 1 K. W. transformer, Murdock condensers, oscillation transformer, aerial inductance, rotary gap with speed of 8,000 R. P. M. and commercial key.

Receiving set consists of: Navy type tuner, two variable condensers, Audion detector and amplifier; the latter two instruments of the writer's own manufacture.

The apparatus are controlled by the large switch-board shown at the right-hand side of the picture.

Mr. Howard S. M. White, Prize Winner This Month. He Obtains Excellent Results, Both Transmitting and Receiving, with His Radio Set, Which Is Quite Complete as Becomes Apparent. Note the Neat Arrangement of the Lay-Out.



Though my aerial is only ninety feet long and seventy-five feet high I have obtained very remarkable results, working daily with 9 B. W. of Omaha, Neb., and 9XT of Lincoln, Neb., a distance of over a hundred miles. Time signals can be heard in the daytime from Arlington, Key West and Springfield. We are able to hear stations on the Atlantic, Pacific and Gulf Coasts, as well as many ship stations in either ocean.

I have been a student of wireless for the past four years. Am a member of the American Radio Relay League, the Central Radio Association, the Hawkeye Radio Association and have a Government license; call 9JH.

HOWARD S. M. WHITE.
Sioux City, Iowa.

On February eighth, the governor of Bombay, India, closed a switch on the 100,000 volt transmission line of the Tata high head system, and energy was transmitted to Bombay for the first time from the power house, forty-three miles away.

RADIO STATION OF W. A. SOMERS.

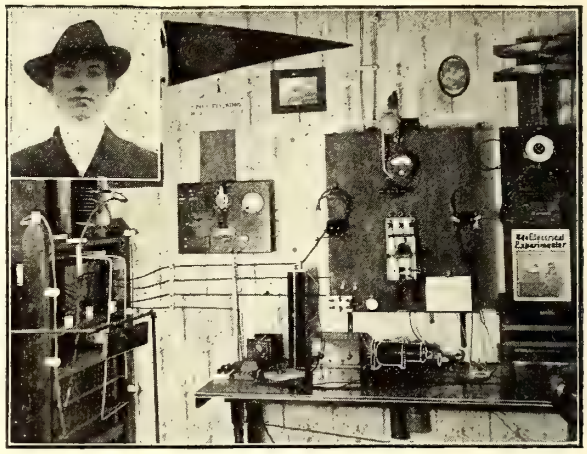
For sending I have a 1 K. W. Edgcomb-Pyle transformer, a line protector plate condenser, rotary spark gap and an oscillation transformer, which is at the left of the picture. I also use a ½ K.W. Electric Importing Company transformer with this set. At the right I have a small sending set for town use. This consists of a 1" spark coil, home-made oscillation transformer, spark gap, condenser and hot wire meter.

The receiving set consists of a single step amplifier, two pairs of 'phones, Murdock and Western Electric make; two loose couplers, one of which is connected with a loading coil for receiving NAA.

My aerial is 50 ft. high, 60 ft. long, six wires each two feet apart, made of seven-strand phosphor bronze wire.

I hold a second grade commercial radio operator's license and my official call is 8 A N N.

WARREN A. SOMERS.
Bradford, Pa.



Elaborate Radio Station of Mr. Warren A. Somers, Comprising Both Transmitting and Receiving Apparatus. Switch-Boards Simplify the Control of the Various Instruments.

250 AMATEURS TAKE REPORTS IN IOWA.

There are now more than 250 amateur wireless stations in the state of Iowa, according to Professor C. A. Wright of Ames. Practically all are receiving the weather and news reports sent out twice daily from the big wireless station at Ames.

"It is our intention to continue the news service right on through the season," says Professor Wright. "The service is to be improved as soon as feasible and blanks furnished those who want them for bulleting news sent out." The idea of adding general news items to the college news furnished is being favorably considered.

WATCH FOR THE "WIRELESS GIRL" IN NEXT ISSUE!

RADIO SET OF G. M. COTTRELL.

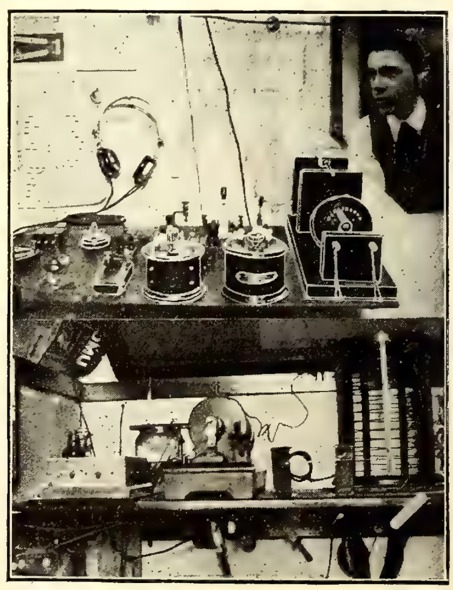
The aerial of my station is composed of four wires, 60 feet high and 150 feet long. My receiving outfit consists of a Murdock 4,000 meter loose coupler, Crystaloi detector with resonator and constant amplitude buzzer, Murdock primary and secondary variables, a tikker, two Murdock large fixed condensers, Brandes' 3,000 ohm headset.

For sending I use an E. I. Co. ½ K. W. coil, electrolytic interrupter, large and small sending condensers, helix with pilot lamp and heavy contact key.

I have been a wireless experimenter for five years and THE ELECTRICAL EXPERIMENTER has been my chief help in most of the work undertaken.

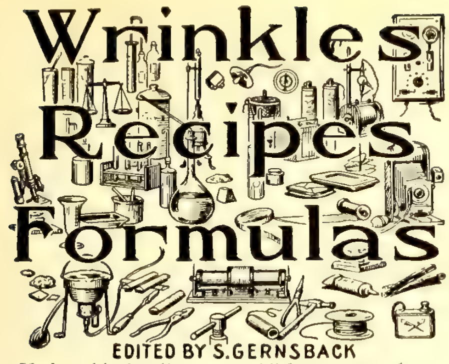
I talk nightly with several amateurs thirty-five miles away. I use only half of my aerial when sending. My greatest receiving range is Key West, about 1,900 miles air line. With the tikker I hear Sayville's war news. I have heard N A A during heavy rain and snow storms.

My tikker is only a home-made instrument, and I am thinking of applying for a patent on it because its operation has proved very successful.



Upper View Shows Mr. Cottrell's Wireless Receiving Set; Below—His Transmitting Apparatus.

GORHAM COTTRELL.
Quincy, Ill.



Under this heading we publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 25.

Ormolu Coloring Lacquers, Etc.

Ormolu Coloring.—Alum, 30 parts; nitrate of potassa, 30 parts; red ochre, 30 parts; sulphate of zinc, 8 parts; common salt, 1 part; sulphate of iron, 1 part. It is applied with a soft brush. The articles are placed over a clear charcoal fire until the salts, melted and dried, assume a brown aspect. They are then suddenly cooled in nitric acid water, containing 3 per cent. of hydrochloric acid, afterwards, washed in abundance of water and dried in sawdust.

To Prepare Brass Work for Ormolu Dipping.—If the work is oily, boil it in lye, and if it is finished work, filed or turned, dip it in old acid, and it is then ready to be ormolued, but if it is unfinished and free from oil, pickle it in strong sulphuric acid, dip in pure nitric acid, and then in the old acid, after which it will be ready for ormoluing.

To Repair Old Nitric Acid Ormolu Dips.—If the work after dipping appears coarse and spotted, add vitriol till it answers the purpose: if the work after dipping appears too smooth, add muriatic acid and nitrate till it gives the right appearance. The other ormolu dips should be repaired according to the receipts, putting in the proper ingredients to strengthen them. They should not be allowed to settle, but should be stirred often while using.

Directions for Making Lacquer.—Mix the ingredients, and let the vessel containing them stand in the sun, or in a place slightly warmed, 3 or 4 days, shakig it frequently till gum is dissolved, after which let it settle from 24 to 48 hours, when the clear liquor may be poured off for use. Pulverized glass is sometimes used in making lacquer to carry down the impurities.

Lacquer for Dipped Brass.—Alcohol, (95 per cent.) 2 gals.; seed lac, 1 lb.; gum copal, 1 oz.; English saffron, 1 oz.; annatto, 1 oz.

Lacquer for Bronzed Brass.—To 1 pt. of the above lacquer add gamboge, 1 oz., and, after mixing it, add an equal quantity of the first lacquer.

Deep Gold Colored Lacquer.—Best alcohol, 4 ozs.; Spanish annatto, 8 ozs.; turmeric, 2 drs.; shellac, ½ oz.; red sanders, 12 grs.; when dissolved, add spts. of turpentine, 30 drops.

Deep Gold Colored Lacquer for Brass Not Dipped.—Alcohol, 4 gals.; turmeric, 3 lbs.; gamboge, 3 ozs.; gum sandarac, 7 lbs.; shellac, 1½ lbs.; turpentine varnish, 1 pt.

Gold Colored Lacquer for Dipped Brass.—Alcohol, 36 ozs.; amber, 2 ozs.; gum gutta, 2 ozs.; red sandal wood, 24 grs.; dragon's blood, 60 grs.; oriental saffron, 36 grs.; pulverized glass, 4 ozs.

Gold Lacquer for Brass.—Seed lac, 6 ozs.; amber or copal, 2 ozs.; best alcohol, 4 gals.; pulverized glass, 4 ozs.; dragon's blood, 40 grs.; extract of red sandal wood obtained by water, 30 grs.

Lacquer for Dipped Brass.—Alcohol, 12 gals.; seed lac, 8 lbs.; turmeric, 1 lb. to a gal. of the above mixture; Spanish saffron, 4 ozs. The saffron is to be added for bronzed work.

Good Lacquer.—Alcohol, 8 ozs.; gamboge, 1 oz.; shellac, 3 ozs.; annatto, 1 oz.; solution of 3 ozs. of seed lac in 1 pt. alcohol. When dissolved, add ½ oz. Venice turpentine, ¼ oz. dragon's blood, will make it dark. Keep it in a warm place 4 or 5 days.

Pale Lacquer for Tin Plate.—Best alcohol, 8 ozs.; turmeric, 4 drs.; hay saffron, 2 dr.; dragon's blood, 4 drs.; red sanders, 1 dr.; shellac, 1 oz.; gum sandarac, 2 drs.; gum mastic, 2 drs.; Canada balsam, 2 drs.; when dissolved, add spts. turpentine, 80 drops.

Red lacquer for Brass.—Alcohol, 8 gals.; dragon's blood, 4 lbs.; Spanish annatto, 12 lbs.; gum sandarac, 13 lbs.; turpentine, 1 gal.

Pale Lacquer for Brass.—Alcohol, 2 gals.; cape aloes, cut small, 3 ozs.; pale shellac, 1 lb.; gamboge, 1 oz.

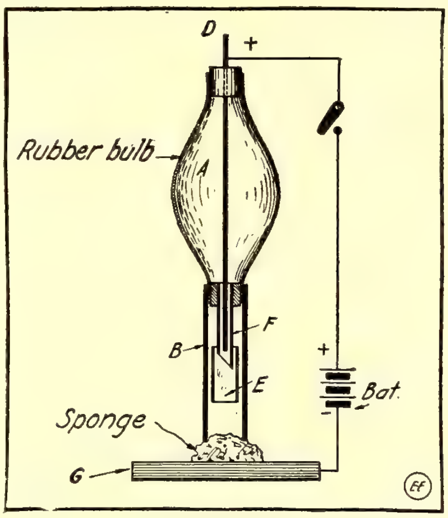
Best Lacquer for Brass.—Alcohol, 4 gals.; shellac, 2 lbs.; amber gum, 1 lb.; copal, 20 ozs.; seed lac, 3 lbs.; saffron to color; pulverized glass, 8 ozs.

Color for Lacquer.—Alcohol, 1 qt.; annatto, 4 ozs.

Gilder's Pickle.—Alum and common salt, each, 1 oz.; nitre, 2 ozs.; dissolved in water, ½ pt. Used to impart a rich yellow color to gold surfaces. It is best largely diluted with water. S. G.

A HAND ELECTROPLATING OUTFIT.

The plating outfit consists of a rubber ball, A, fitted at one end with a glass tube,



A Neat System of Electroplating, Eliminating the Usual Muss and Trouble.

B, which carries a small sponge. Rod D passes through the rubber ball into the glass tube, B, and carries at that end the anode E. A small glass tube, F, also connects the rubber ball with the larger tube, B. The connections from the battery to the cathode G, the object to be plated, and to the projecting end of the anode carrying rod D are made as in the diagram. The rubber ball is filled with the electroplating fluid and is squeezed so as to force the fluid through the small tube, F, into the larger tube, B, filling it and soaking the sponge.

The current is then turned on and by moving the wet sponge over the cathode, G, the latter will be plated.

Contributed by GEO. SWANDA.

HOW TO PREVENT PEN POINTS FROM GETTING RUSTY.

To prevent pens from becoming rusty place a few old pen points (or some pieces of iron wire) in your ink supply. The pens eat up the acid in the ink and thereby keep your pen free from the acid.

Contributed by ALEXANDER V. BOLLERER.

POLE TEST PAPER.

Undoubtedly many amateur electricians have been annoyed by the trouble in finding which was the positive, and which was the negative of the two wires, especially when the source of current could not be reached or where the wires were twisted so as to make it difficult to distinguish one from the other. In storage cells and batteries the poles are frequently not marked and to find the positive and the negative poles one will have to resort to a polarity indicator, which is an expensive instrument for most experimenters.

A simple method of getting rid of this annoyance with but little expense is as follows: At a drug or chemical store procure some red litmus paper and thoroughly soak it in a solution of one tablespoonful of salt in a tumbler full of water. When thoroughly soaked remove the paper from the solution and carefully, so as not to tear it, hang it up to dry in such a manner that it will not touch anything but the means of support.

NOTE:—Do not try to dry the paper between sheets of blotting paper as this will absorb some of the salt solution and render the pole test paper insensitive to small voltages.

When dry the pole test paper is ready for use. It is used as follows: Take a strip of the paper measuring about one-half inch by one and one-half inches and moisten it slightly with water. Then place the ends of the wires to be tested on the paper in such a position that they will be about three-quarters of an inch apart.

If there is a potential difference (voltage) between the two wires, a deep red spot will appear on the paper at one of the wires and a blue spot will appear at the other wire. The wire at which the blue spot appears is the *negative* and the one at which the red spot shows up is the *positive*.

When the potential difference between the wires is low the red spot will sometimes not show. As the blue spot, however, will appear, it will indicate the negative wire; the other, therefore, being positive.

If you cannot obtain red litmus paper, use blue litmus paper instead. The blue spot, however, will not show up very noticeably in this case, but the red spot will indicate the positive wire and the other wire will therefore of necessity be the negative one.

If unable to procure litmus paper, it can be prepared as follows: Boil some red cabbage leaves in water until a concoction of a deep reddish purple is obtained. Treat this concoction with a few drops of white vinegar until it turns to a brighter red color. Into this solution dip pieces of filter, blotting or unglazed paper. When dry the color of the paper should be a deep pink. If it is lighter the red cabbage solution should be boiled longer. The paper thus treated can then, after drying, be treated with the salt solution to make the pole test paper as previously described.

After using pole test paper it can be dried and laid aside to be used over again. After it is worn out it may be renewed as follows: Dip into vinegar until all blue spots disappear, then dip into water so as to remove the vinegar, then soak in salt solution as described above and the paper will be as good as new. This can be repeated any number of times until the paper tears.

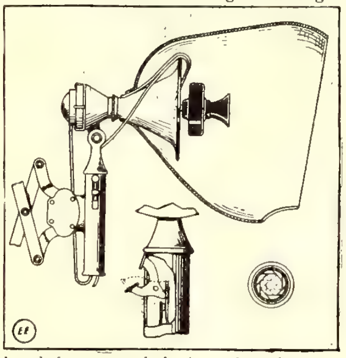
Contributed by K. KIRSCH and F. L. BUCHHOLZ.

LATEST PATENTS

Novel Combination Telephone

(No. 1,180,147; issued to Rosa D. Hatch.)

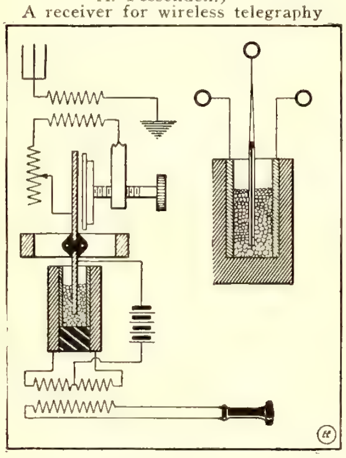
This unique combination telephone transmitter and receiver involves the use of a horn on the receiver to amplify the sound. In front of the horn and inside the large muffling hood is suspended the microphone. One may thus hear without placing the receiver to the ear and the incoming sounds are, moreover, directed, by virtue of the hood, to the ears of the person using the instrument. An iris diaphragm is fitted to the receiver horn to adjust the resonance of the sound chambers.



Radio Detector.

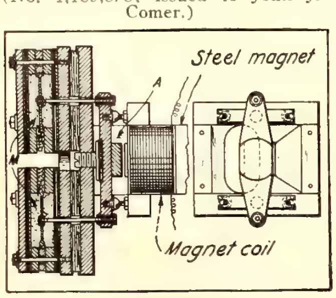
(No. 1,179,906; issued to Reginald A. Fessenden.)

A receiver for wireless telegraphy comprising a movable mica diaphragm, a platinum leaf thereon, a fixed plate statically attracted by said movable plate, a microphonic material between the movable and fixed plates, whereby the motion of the movable plate may be indicated by variation of resistance of said microphonic material. The device acts as an amplifier and Dr. Fessenden states that it has proved superior in sensitiveness to the liquid barretter.



Telephone Amplifier

(No. 1,185,878; issued to John J. Comer.)

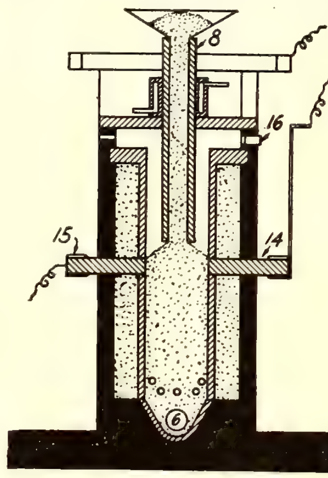


Improved telephonic amplifier device incorporating a steel "U" magnet, an electro-magnet coil, actuating an iron armature "A", attached by tie rods to diaphragms of two microphones M. Armature "A" spring mounted. Felt rings absorb all extraneous sound waves. Adapted to commercial voltage circuits and capable of controlling as many as 500 loud speaking reproducers from a single master transmitter attached to a phonograph or used in the regular way to gather up speech sounds.

Electric Furnace

(No. 1,184,817; issued to J. W. Brown.)

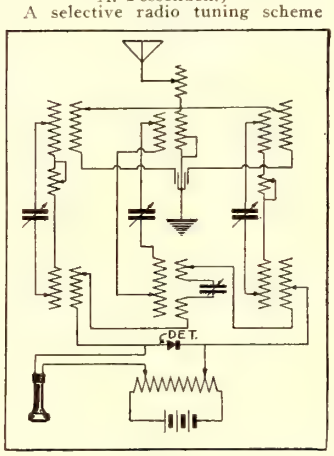
An electric furnace intended especially for fusing or treating finely divided carbon. The latter is fed downward through a hollow electrode as indicated. The electrode is cooled by a water jacket. The treated material passes through an orifice 6 at the base. Single or polyphase A.C. may be used with this furnace. Current passes through the hollow electrode 8 and two side electrodes 14 and 15. Hot gases may be removed through a side opening 16.



Radio Tuning Scheme

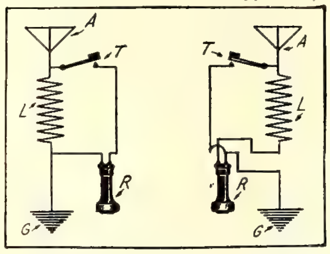
(No. 1,184,843; issued to Reginald A. Fessenden.)

A selective radio tuning scheme relating to methods of weeding out disturbances, such as signals from other stations, utilizes three circuits, all very sharply tuned and with very small damping so as to allow a larger resonant rise; one circuit being tuned to the period at which it is desired to receive, one tuned to a higher period and the other to a lower period. The higher and lower circuits may be made to neutralize the effect of disturbing impulses produced on the receiver by the properly tuned circuit. Involves the use in some cases of a mono-telephone receiver as described in patent. With the receiver tuned to group and wave frequencies the inventor claims entire freedom from all disturbances, is attained.



Detector-less Receiver for Radio

(No. 1,185,711; issued to G. W. Pickard, of New York City, N.Y.)

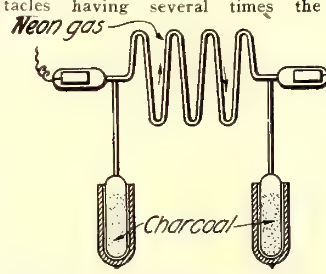


Improved method, it is claimed, of interpreting received radio signals from spark or undamped wave stations, which consists of storing the energy of the incoming oscillations around an inductance in the form of a magnetic field, and then discharging this stored energy in the form of a pulse of current, this action resulting from a vibrating interrupter T. With spark sending the inventor has attained good results with simply a key at T operated by hand. Adaptable also to radio-telephony. The radio frequency current here operates the one ohm 'phone directly without any detector.

Neon Tube

(No. 1,189,664; issued to Georges Claude.)

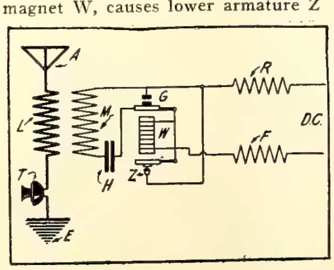
To supplement the usual methods used to purify neon gas, a French inventor is using auxiliary receptacles having several times the capacity of a neon tube. By passing a spark through the tube a respiration takes place between the charcoal in the receptacles and tube, conversely. Using a more intense cold than liquid air, such as liquid hydrogen, a circulation of gas can be created in the tube, while the spark is only employed to release the impurities.



Radio Spark Gap Device

(No. 1,186,455; issued to W. Torikata, E. Yokoyama and M. Kitamura.)

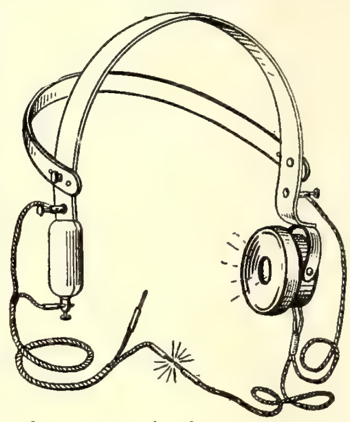
A self-regulating spark gap for use on direct current service, suited to the production of high frequency currents in a tuned circuit GMH. The D.C. passing through electromagnet W, causes lower armature Z to break coil circuit, inducing a high self-inductance E.M.F. capable of breaking down resistance of spark gap G. After passage of the initial spark, the gap becomes ionized and a strong current, which was at the beginning cut off by the high resistance in the electrode circuit, will be able to flow through the gap circuit. Great constancy in oscillation production is claimed.



Phone Tester for Electric Circuits

(No. 1,187,500; issued to G. B. Raymond.)

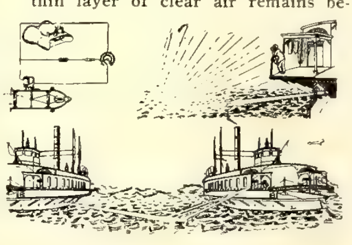
Effective testing instrument for locating short and open circuits in electric wiring or dynamo and motor windings. It comprises an ordinary telephone receiver, headband, flashlight battery and test cords. The battery fits into a neat metal casing mounted on side of the head band as shown. The 'phone, so used, constitutes one of the most sensitive testing devices known, superior in many ways to the galvanometer.



Fog Signaling Device for Ships

(No. 1,184,783; issued to G. B. Speed.)

Intermittent light beam, controlled by electrically actuated shutter in reflector hood, is played on water from a low altitude. Observer on opposite boat uses binoculars fitted with shutter which cuts off view whenever intermittent flashes are sent out from his vessel. System operates on the principle that fog is less dense near the water, as a thin layer of clear air remains between fog and water. It is intended to aid prevention of collisions.



In order that the observer, who as explained above should be located on the vessel as near the water line as possible, may not be dazzled by the reflection from the fog due to the light from his own vessel, special shutter spectacles are provided. As shown these spectacles are provided with a shutter operated in synchronism with the porthole shutters. The spectacle-shutter may consist of a lever at each end of which is a disk adapted to cover the opening or object glass of the spectacles. This lever may carry an armature adapted to co-operate with an electromagnet, the latter receiving current at the proper interval from the controller.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 !! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

WATT ISAWATT, OF KURRENT, D. C.

AERO BED FIRE ESCAPE

No. & $\sqrt{\ } = \frac{1}{CUSO_4}$ **Specifications Specialized** **Patent Appled**

To Whom It Mought Concert:

Be it beknown that I, Watt Isawatt of the City of Kurrent in the State of Dreadful Consternation have promulgated and preconceived certain new improvements in life saving apparatuses.

It is a well known geographical fact, already beknown to the ancients, that when a fire breaks out on the upper floors of a dwelling, panicstroked bipeds of the class of *homo sapiens* suddenly are seized with an uncontrollable desire to learn the art of flying. Being deprived of wings the experiment usually fails, *i.e.,* the luckless flyers as a rule land on their *Coko Cranikums* thereby doing great damage to the concrete sidewalks. At the present high cost of cement (due to the shortage of imported air, on account of the war and the English censure of the mails) it becomes necessary to find ways and means to prevent the useless and widespread destruction of the sidewalks.

In a separate Pattent Applification I describe how the cement or concrete sidewalk can be made so elastic that amateur flyers landing on their *Coko Cranikums* will bounce up and down for a certain length of time, the time being directly proportional to the square root of the density of their *Cranikums.*

In the present, unintelligible presentation however, the ethnological means is arrived at by a different manner, as will be more fully under and overstood from the below appearing descriptive description:

This is the *modus operansky* of the aero-bed 'fire escape'. When a fire breaks out in a skyscraper, the heat actuates thermostat 1, which closes the motor circuit, and the motor, 2, raises a section 3 in the side of the building. 4 is an ordinary (very ordinary) bed, equipped with castors (not castor oil) or landing skids.

Thermostat 5, under the bed operates at 1° higher than 1. When the thermostat closes, the solonoid 6 (see insert), operated by storage battery 7, draws in plunger 8, and spreads out the wings 9. The motor, 10, is also started, whirling the propeller at a tremendous rate. The bed is then ready to fly away as soon as thermostat 11 closes circuit through solenoid 12. This draws away the floor support 13, and drops the floor with such force that the bed makes a sudden dive for freedom. Steering is then accomplished by means of the rudder and one's feet.

After the Biped is properly awakened he can fly around the block till breakfast time if he so chooses. Or if he has foresight enough to corral his clothes to the bed in the evening, he can dress *en route* and fly directly to his office, in order to beat the office boy to it and call him down because he is 3¼ minutes late.

A highly important use of my invention is also found in its application for hospitals. It is a well known caloric fact that fever patients are apt to become hot, or rather heated. Cases are known where the fever has gone up so high as to set fire to the mattress. High fever cases also heat up the ward in an annoying manner. Thanks to my invention this can never happen, for, when the patient becomes sufficiently hot, the thermostat 5, under the bed acts and he departs hurriedly. By means of an automatic steering arrangement, the aero-bed returns to the ward as soon as the patient has cooled down sufficiently.

What I claim is:

1° An aero-bed-fire-escape apparatus enabling municipalities to save sidewalks from destruction.

2° A flying-bed-aero pleasure vehicle enabling tired business Bipeds to watch a blaze from the front rank.

3° An aero-fire-escaping bed, enabling beds to escape the fire by aero, and enabling the fire to escape the aero-beds.

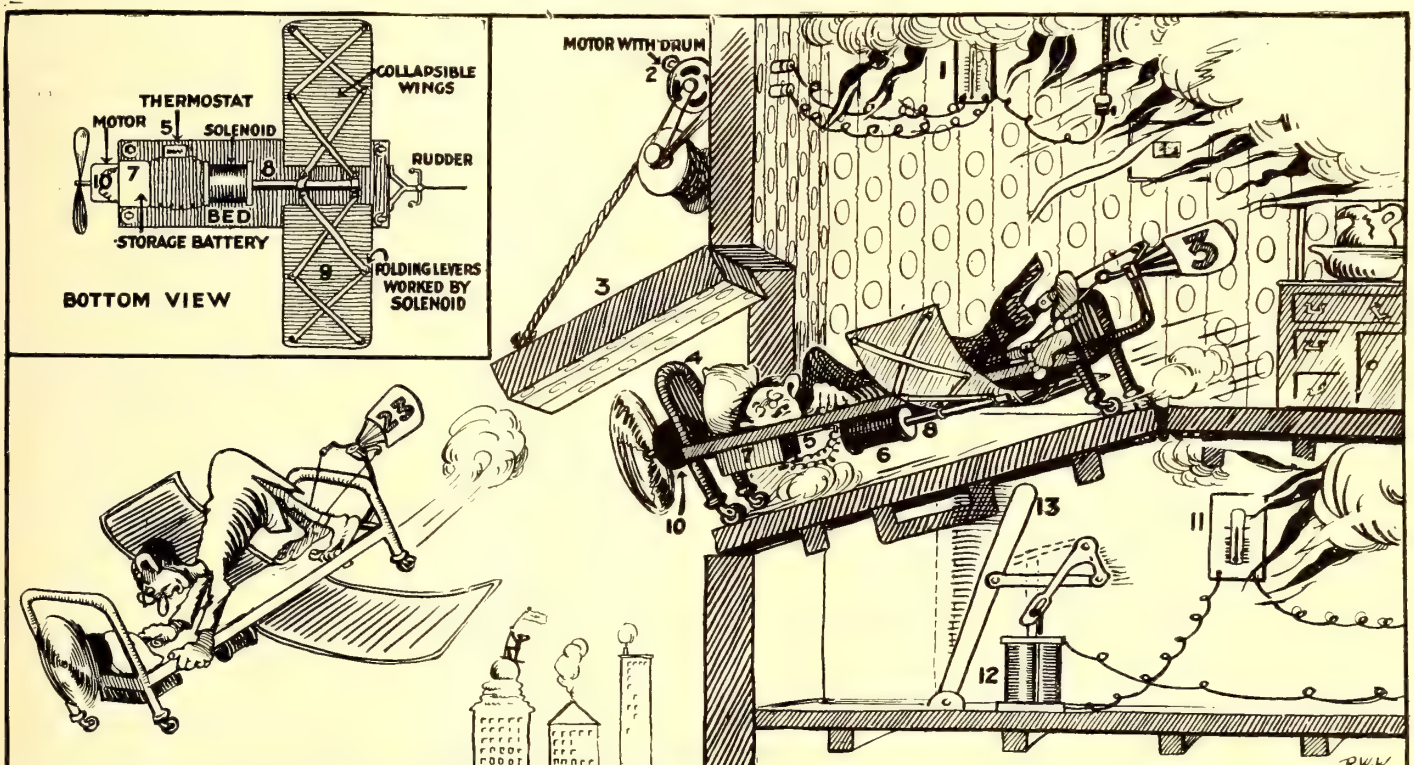
In witness thereunder I have emplaced hereon my phizst this here 19th night of Achdulieberaugust 19½6.

(Signed) WATT ISAWATT,

By his Attorney,
Raymond Anderson.

Fitnesses:

B. Y. Heck.
P. A. Tent.
F. Lea Byte.



No Longer Need You Be Fried to Death in Case of Fire While Asleep in a Tall House. Thanks to Mr. Watt Isawatt's Aero-Bed-Fire-Escape Your Exit to Safety Is Made Automatically and You Get a Free Ride Besides.

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

VARIOMETER.

(597.) E. Dawlson, Santa Fé, N. Mex., inquires:

Q. 1. Can an ordinary loose coupler be used as a variometer?

A. 1. Yes, providing the windings of both the primary and secondary coils are wound with the same size wire and of a large size. The primary coil is connected in series with the secondary in such a manner that their magnetic fields oppose each other. Results obtained with such an arrangement will not be as efficient as if the coupling is varied at right angles to each other. In this case a large space is necessary in order to obtain the same amount of coupling as if the coils were turned at angle to each other, as in the standard type variometer.

Q. 2. Would the sensitiveness of crystal detectors be increased if they were heated?

A. 2. Some rectifying crystals increase their sensitiveness when they are slightly heated, such as molybdenum and silicon. This is done by placing the whole detector on a sand bath, which is heated either by an alcohol torch or a bunsen burner. It should not be heated more than about 5 to 8 degrees above the surrounding atmosphere.

PHOTO ELECTRICITY.

(598.) P. Gilsen, Providence, R.I., asks:

Q. 1. What is photo electricity?

A. 1. Photo electricity is the property possessed by certain elements of emitting electrons or negatively charged particles when exposed to sunlight, in such a manner that one element is entirely shielded from the light while the second one is highly exposed to it.

The study of photo electricity is still in its infancy, and the subject is still open for extensive research.

Q. 2. What is the chemical formula for glyceryl stearate, and what is its chemical reaction with sodium hydroxide?

A. 2. The formula for glyceryl stearate is $C_3H_5(C_{18}H_{35}O_2)_3$, and its chemical reaction with sodium hydroxide is $C_3H_5(C_{18}H_{35}O_2)_3 + 3NaOH = C_3H_5(OH)_3 + 3NaC_{18}H_{35}O_2$. The last product of the reaction is called sodium stearate or hard soap. Soft soap is produced by using potassium hydroxide instead of sodium hydroxide.

ARMATURE.

(599.) John Haysel, Pittsburgh, Pa., wishes to know:

Q. 1. What is the armature of a dynamo?

A. 1. The armature is the part of the machine in which the E. M. F. is produced, or in which the current is generated. As a rule the armature revolves and the field is stationary, but in a few alternators the armature is stationary and the field coils revolve.

Q. 2. Could a pair of high resistance telephones be used in the grid circuit of an oscillating audion, instead of an inductance coil?

A. 2. Yes.

Q. 3. Does a dynamo or motor always have an even number of poles?

A. 3. There are as many "north" as there are "south." The poles are sometimes divided differently, but the north and south poles are equal in number.

TRANSFORMER.

(600.) Charles Appleby, Newburg, N.Y., asks:

Q. 1. Does the resistance of the primary circuit of a transformer change, so as to let more current pass when the secondary gives more current?

A. 1. No. The true or D.C. resistance of the primary circuit remains constant. However, Ohm's law in its simple form does not always hold true for alternating currents. For instance, when the primary circuit of the transformer has a resistance of about 30 ohms, more than 330 amperes may pass when such a resistance is connected across a 1,000 volt D.C. circuit, but only a fraction of this current would pass at the same potential on an A.C. circuit due to the impedance reactance.

Q. 2. Will the load be evenly divided if two transformers have the secondaries connected in multiple?

A. 2. It will if the two transformers have similar regulations; that is, if the voltage drops off the same amount at half load, or at full load.

Q. 3. How does Ohm's law apply to a circuit containing counter-electromotive force?

A. 3. The C. E. M. F. may be considered as reducing the total E. M. F. and Ohm's law becomes: current equals E. M. F. minus C. E. M. F. divided by resistance, therefore I=E. M. F.—C. E. M. F.

TO OUR FRIENDS.

Do you realize that not one day passes when we do not receive from 150 to 250 letters addressed to the "Question Box"? If we were to publish all the questions and their answers we would require a monthly magazine five or six times the size of The Electrical Experimenter with no other matter but questions and answers! Of late the influx of letters has become so heavy that several of our associates have been forced to discontinue important editorial work, in order to answer the mail. This we are certain you do not wish. You do not want your magazine to lower its present high standard. You want the best, the very best, and you know we never have failed you yet.

Moreover the multitude of letters are wholly unnecessary. Most of the questions we are asked every day have been answered before in the Question Box. Therefore ere you sit down to write to us, look over your back numbers and nine times out of ten you will find the answer.

We strive hard to publish only such matter as has not appeared before in our columns, and for that reason only a small fraction of queries of those received by us are actually published.

Kindly note, therefore, that in the future we can not, in your own interest, answer questions by mail, free of charge.

For questions requiring immediate answer our fee is 25c. for the first three ordinary questions and 25c. for each additional question. We will gladly advise fee for special questions entailing considerable calculations or research. Stamped and addressed envelope should be enclosed with the queries and, moreover, any sketches accompanying them should be made on separate sheets. And please be brief.

THE EDITORS.

BATTERY.

(601.) Paul Stutz, Albany, N.Y., inquires:

Q. 1. What is a voltaic or galvanic battery?

A. 1. These are simply different names for chemical batteries. Volta and Galvani are the two men who divide honors for discovering the principle and inventing the battery cells bearing these names.

Q. 2. What is the difference between a primary and secondary battery?

A. 2. When a primary battery is exhausted, it is necessary, as a rule, to throw away the electrolyte and supply a new one, also frequently renewing the electrodes. Storage batteries are recharged by sending a current through them in the opposite direction from that which the battery delivers, the same electrolyte and electrodes being used over and over again. In the secondary or sto ge battery there is no actual *storing* of electricity. The charging current reverses certain chemical actions and the energy that is stored is *chemical* rather than *electrical*. The only case where electricity is actually stored is in the condenser or Leyden jar.

METALLIC FLAME LAMP.

(602.) J. Russel, Denver, Colo., wants to know:

Q. 1. What is a metallic flame lamp?

A. 1. In these lamps the negative electrode furnishes the material for the arc vapor and consists of a thin steel tube, packed with oxides of metals, such as iron (magnetite) titanium or chronium. In vaporizing, they add great luminosity to the arc, leaving a considerable amount of fluffy soot behind, however, which is carried away by special ventilation means. One electrode is directly above the other.

Q. 2. Is any use other than lighting made of the high temperature of the arc?

A. 2. Various processes for welding metals and for the reduction of metals or other metallurgical work have been developed both from the heat of the arc and also from the heat from the ordinary operation of the current.

Q. 3. What is meant by a sinusoidal current?

A. 3. A sinusoidal current is a common variety of alternating current in which the current gradually increases from zero to a maximum positive value. It then becomes weaker until it reaches zero, changing direction and gradually rising to a maximum negative value and so on.

(*Continued on page 354*)

QUESTION BOX.

(*Continued from page 352*)

CARBORUNDUM.

(603.) P. Fletcher, Richmond, Va., inquires:

Q. 1. How is ordinary carborundum made, and give the chemical reaction?

A. 1. The material is made in an electric furnace from a mixture of sand, coke, sawdust and salt. The real action is in the sand, which is an oxide of silicon SiO_2, often called silica. The mixture facilitates the escape of gases. The salt seems to act as a sort of flux. At the high temperature the silica is dissociated, the silicon melting with carbon (from the burned sawdust) to form carbide of silicon SiC, and its oxygen uniting with other carbon to form carbon monoxide CO, which then unites with more oxygen from the air, and burns into carbonic acid gas CO_2. The chemical reaction is as follows: $SiO_2+3\,C=SiC+2\,CO$. The carbide of silicon SiC or carborundum forms a small mass of thin crystals having beautiful colors. These are crushed and made into various shapes for abrasives.

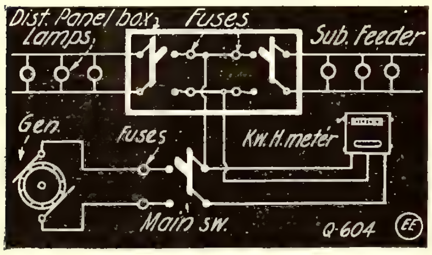
Q. 2. What is a "bug" cut-out?

A. 2. Bug cut-outs are small single pole cut-outs for placing in cramped and awkward places, such as in electric lighting fixtures where a regular fuse block cannot be used. Their use is practically prohibited to-day.

ELECTRIC WIRING.

(604.) Paul Zender, Hoboken, N.J., asks:

Q. 1. How should the distributing centers or cut-out cabinets be located?



Showing Usual Arrangement of Panel Board in House Wiring Layout for Light.

A. 1. They should be installed near a partition that is so located as to make the running of rises easy, and should be on an inside wall to guard against dampness.

Q. 2. What provisions should be made in wiring a hallway?

A. 2. The switching arrangements should be so designed that the lights may be turned on from the hall and the floor below or above.

Q. 3. What wiring system should be used with private plants?

A. 3. The two-wire multiple circuit system. A schematic diagram is illustrated here.

MEASURING INSTRUMENTS.

(605.) I. Straus, Schenectady, N.Y., wants to know:

Q. 1. What is a bolometer?

A. 1. A common form of bolometer consists of two similar circuits containing conductors of a material whose resistance changes rapidly with changes of temperature. These are arranged so that one may be exposed to the source of heat under investigation, while the other is protected from it. The two currents are connected respectively to the two coils of a differential galvanometer, which are wound or connected oppositely, so that the needle is only affected by the *difference* between the currents flow through the two coils. When both circuits are connected to the same battery and both are at the same temperature, equal currents flow through the two coils and the needle is not affected. But if the temperature of one is different from that of the other, then the resistances vary and the currents no longer balance, thus causing a deflection of the needle. Such instruments have been made so sensitive as to be affected by the heat from a candle several miles distant, and even measure the heat from distant stars. (See January, 1916, issue of THE ELECTRICAL EXPERIMENTER—"Measuring the Heat of Distant Stars.")

THE subscription price of this publication will be raised from $1.00 to $1.50 in a very short time. See our announcement in the July issue. If you wish to save money, now is the time to subscribe at the old rate: $1.00 a year, $2.00 two years, etc., and $5.00 for five years. (Foreign and Canadian add $0.50 per year for postage.) If you are a subscriber you will profit by extending your subscription for one or more years. No subscriptions accepted for a longer period than five years. ACT NOW, before this chance is gone.

RADIO QUERIES.

(606.) P. Langman, Seattle, Wash., writes:

Q. 1. What is the natural wave length of my aerial, composed of four wires 175 feet long, elevated 100 feet from the ground? The wires are separated from each other by a distance of 2 feet.

A. 1. The natural wave length of your antenna is 530 meters.

Q. 2. What is the advantage of a loose coupler over a tuning coil?

A. 2. Sharper tuning is obtained with the use of an inductively coupled tuner.

Q. 3. What is the formula for obtaining the frequency generated by a Poulsen arc?

A. 3. The formula is:—

$$F = \frac{5.033 \times 10^6}{\sqrt{\text{Cap. M.F.} \times \text{Ind. Cms.}}};$$

where: F is frequency of oscillations in cycles per second.

FARADAY'S PRINCIPLE.

(607.) I. Bonehard, Montreal, Canada, wishes to know:

Q. 1. What is Faraday's principle of electromagnetic induction?

A. 1. When a conducting circuit is moved in a magnetic field so as to alter the number of lines of force passing through it, a current is induced therein, in a direction at right angles to the direction of the motion, and at right angles also to the direction of the lines of force, and to the right of the lines of force as viewed from the point from which the motion originated.

Q. 2. Explain just what happens when a current is induced by electromagnetic induction.

A. 2. In order to induce an electromotive force by moving a conductor across a uniform magnetic field, it is necessary that the conductor in its motion, should so cut the magnetic lines as to alter the number of lines of force that pass through the circuit of which the moving conductor forms a part.

Q. 3. What is the proper name for a conductor which moves across the magnetic field?

A. 3. An *inductor*, because it is that part of the electric circuit, in which induction takes place.

ELECTRICAL UNITS DEFINED.

(608.) Paul Jerome, St. Louis, Mo., inquires:

Q. 1. What is the International ampere and henry?

A. 1. The International unit of electrical current is the ampere, which is one-tenth of the unit of current of the centimeter-gram-second system of electromagnetic units, and is the practical equivalent of the unvarying current, which, when passed through a solution of nitrate of silver in water, in accordance with standard specifications deposits silver at the rate of .001118 gram per second.

The unit of induction is called the henry, which is the induction in a circuit when the electromotive force induced in the circuit is one International volt, while the inducing current varies at the rate of 1 ampere per second.

Q. 2. What proportion of the total current is usually taken by the fields of shunt dynamos and motors.

A. 2. It varies from 30% or more in small machines to 1% or less in large machines.

STORAGE BATTERY QUERIES.

(609.) H. Russmore, Brookline, Mass., wishes:

Q. 1. What indicates the completion of a charge in a storage battery?

A. 1. When a cell is fully charged, the electrolyte apparently "boils" and gives off gas freely. The completion of a charge may be determined by the voltmeter which will show whether the normal pressure has been attained. Each cell will then show 2.5 volts.

Q. 2. How is the cadmium test made?

A. 2. A small plate or rod of cadmium is mounted in a hard rubber frame or tube and immersed in the electrolyte. The test consists of taking voltage readings, between the cadmium electrode and the positive or negative plate of the cell. During the charge the cadmium electrode reads negative to the negative plate until the cell is about fully charged, when the reading should be zero. The charge should be continued until the cadmium reads .2 volt positive to the negative while charging at normal rate.

Q. 3. How often should a battery be charged?

A. 3. At least twice a month, even if the use be only slight in proportion to the output capacity.

TESTING RESISTANCE.

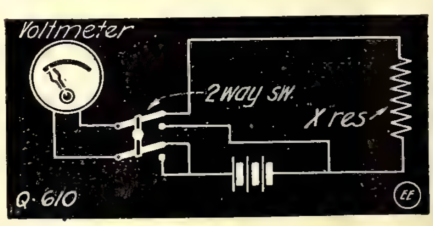
(610.) J. Yates, Baltimore, Md., wishes:

Q. 1. Diagram of connection of the voltmeter method of measuring resistance.

A. 1. The diagram gives the hook-up of the instruments.

Q. 2. How is the method used?

A. 2. Knowing the resistance of the voltmeter, turn switch downward, and from the reading calculate the current corresponding to one division of the scale. Turn the switch upward, multiply reading by current required for deflection of one division. This gives the resistance of the voltmeter and unknown resistance. By substracting from the resistance of the voltmeter gives value of the unknown resistance.



Method of Hooking Up Voltmeter to be Used in Measuring Value of Resistance.

(*Continued on page 356*)

Q. 3. In testing cable insulation, what is desirable with respect to voltmeter and current?

A. 3 A low reading voltmeter should be used in connection with a large battery.

COMPOUND DYNAMO.

(611.) F. Pierson, Sitka, Alaska, asks:

Q. 1. What is the difference between a compound and an over-compounded dynamo?

A. 1. In the first instance there are just enough turns in the series or compound winding to maintain the voltage constant at the brushes for variable load. If a greater number of turns are used in the series winding than is required for constant voltage at the brushes for all loads, the voltage will rise as the load is increased. This makes up for the loss or drop in the transmission line, so that a constant voltage will be maintained at some distant point from the generator. The machine is then said to be over-compounded.

Q. 2. For what service is over-compounding desirable?

A. 2. For incandescent lighting where there is considerable length of transmission lines.

Q. 3. For what service is the series dynamo adapted?

A. 3. It may be used for series arc lighting as a booster for increasing the pressure on a feeder carrying current furnished by some other generator.

ULTRA-AUDION.

(612.) P. Donovan, London, England, wants:

Q. 1. A connection for an Ultra-Audion?

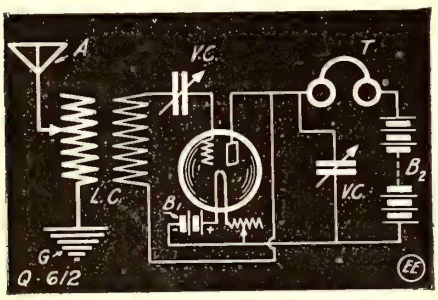
A. 1. The diagram herewith shows the connections.

Q. 2. What crystal detector do you consider the best in connection with a single step Audion amplifier?

A. 2. Practically any of the well-known crystal detectors can be used.

Q. 3. Should the illumination intensities of filaments of a two step amplifier be similar?

A. 3. The intensity of the first filament should be lower than the second. This can be determined by experiment as different Audions have different characteristics. It is therefore difficult to state off-hand how they should be controlled.



Hook-Up for Ultra-Audion.

DETECTORS.

(613.) Louis H. Printz, Waynesville, Ohio, writes for:

Q. 1. Some information on radio transmission without towers, as described in an article in the July, 1916, ELECTRICAL EXPERIMENTER.

A. 1. When no towers are used, a common ground aerial system is employed which is nothing more or less than a wire stretched several feet above the ground or in some cases on the ground.

Q. 2. I would like to learn the nature of the Tel-Radion detector and the Crystaloi?

A. 2. As regards the first detector we do not know its nature and construction details. However, we would suggest that you write the company who manufactures same, the address of which can be obtained from our advertising columns. The Crystaloi consists of a sensitive galena detector from which several contacts are obtained on its surface by means of a large number of certain metallic filings, which are placed in the same receptacle. The connections are made from the crystal and from an opposite plate which touch the filings.

RADIO RECEIVER CONNECTIONS.

(614.) George M. Gilber, Binghamton, N.Y., says:

Q. 1. Why would it not be better to connect a pair of head receivers in parallel instead of series? For instance, two receivers have 1,000 ohm resistance each, and contain 1,000 turns of wire each; .001 volt is passing through them they are series-connected. .001 volt divided by 2,000 ohms equals .0000005 ampere and .0000005 ampere multiplied by 2,000 turns would be .001 ampere-turns. If they were parallel-connected there would be 1,000 turns and only 500 ohms resistance, and if .001 volt was passing there would be .001 volt divided by 500 ohms, which equals .000002 ampere and .000002 ampere times 1,000 turns would be .002 ampere-turns against the .001 ampere-turns of the series connected phones. As it is ampere-turns that we are after and not ohms, I should think it would be better to connect them in parallel.

A. 1. You are correct in theory, but in actual practice radio receivers are invariably connected in series for the reason that there is usually about enough current to satisfy the ampere carrying capacity of a single receiver.

RADIOSON DETECTOR.

(615.) Elmore Slade, New Canaan, Conn., asks:

Q. 1. Is the Radioson detector a good one for portable sets? Has it any serious defects in this use?

A. 1. The Radioson detector is an excellent one for portable sets and it has no serious defects. However, it should be protected from breakage when carrying the portable set.

Q. 2. Can a Radioson detector be used in place of an ordinary electrolytic detector in the hook-up which I submit?

A. 2. The connections are correct and you should not have any trouble in obtaining satisfactory results with this arrangement.

AUDION CURRENT.

(616.) Sanford P. Bordeau, Gilbert, Minn., inquires:

Q. 1. Can the direct current of 80 volts, 4 amperes, developed by an alternating current rectifier bé used in place of the flashlight cells of the "B" battery and the storage battery of the "A" battery of an Audion when used in series with proper resistance?

A. 1. We are very doubtful if you can use the direct current obtained from a rectifier for the high potential current, as the current obtained from such a device is somewhat pulsating and not truly direct.

Q. 2. Is the exhaustion of an Audion bulb necessary for it to rectify or simply to prevent the oxidation of the filament?

A. 2. The exhaustion of an Audion bulb is necessary in order to obtain rectification, and also to prevent the oxidation of the filament when lighted.

Q. 3. What is the wiring plan for obtaining one turn at a time, with two switches, used in nearly all commercial Navy type transformers?

A. 3. We suggest that you refer to the September, 1915, issue of THE ELECTRICAL EXPERIMENTER for obtaining the necessary information regarding the connection of a Navy type loose coupler. Full construction details were given there.

INDUCTIVE CAPACITY.

(617.) J. Logan, Brooklyn, N.Y., wants to know:

Q. 1. What is specific inductive capacity?

A. 1. Specific inductive capacity is the quality of the dielectric which enables it to hold an electric charge between two conductors. Air is taken as a standard, its specific inductive capacity being equal to unity or 1. When two conductors such as two parallel plates are connected to the opposite terminals of a battery or other source of potential difference, the quantity of electricity that flows in or out of the condenser depends upon the nature of the substance between the plates. Thus, if two plates were separated at a given distance by glass the combination would constitute a condenser of about three times what the capacity would be with simple air between the plates; hence the specific inductive capacity of glass is about three.

Q. 2. What causes the humming of telegraph and telephone wires?

A. 2. This is principally due to the mechanical vibration caused by the wind; these vibrations often travel along the wires for miles.

THE AURORA BOREALIS.

(618.) M. Klickburg, Hempstead, L.I., asks:

Q. 1. Does the Aurora in nature have anything to do with electricity?

A. 1. Auroral displays are connected with magnetic storms. The exact cause is not certain, but it is believed to be electrical discharges occurring in the upper atmosphere in consequence of the differing electrical conductions between the cold air of the polar regions and the warmer streams of air in vapor, raised from the level of the ocean in tropical regions, caused by the heat of the sun. We would refer you to the October, 1915, issue of THE ELECTRICAL EXPERIMENTER for valuable information on this interesting subject.

Q. 2. Is the "per cent drop" calculated from the voltage at the dynamo, or that at the lamps?

A. 2. It is commonly calculated from the volts at the lamps, but ordinarily it does not make sufficient difference to change the size wire a single number, so that either voltage may be ordinarily taken as the base.

LAMP QUERIES.

(619.) N. Vandale, Manila, Cuba, asks:

Q. 1. Why is the upper carbon of an arc lamp positive?

A. 1. The positive carbon has a crater which is very hot and emits a major part of the light from the arc. This light from the crater is in a downward direction, if the upper carbon is the positive pole. It thus avoids the use of reflectors or diffusers with the increased cost and lower efficiency.

Q. 2. Why are springs used on the arma-

(*Continued on page 360*)

Selenium Cells

MADE IN AMERICA

FOR eleven years we have been the largest distributors of selenium cells in the world. We have actually sold more such cells than all other houses combined.

Before the European War broke out we had been selling the well-known Gripenberg cell exclusively, but inasmuch as this cell is an imported one, we have not been able to secure it for nearly a year.

We now present for the first time in history a wonderful American-made Selenium Cell, much more efficient than ANY cell ever handled by us. It will rank high in electrical circles as it has several valuable points not usually found in such cells. We unhesitatingly recommend it and stand back of all our claims.

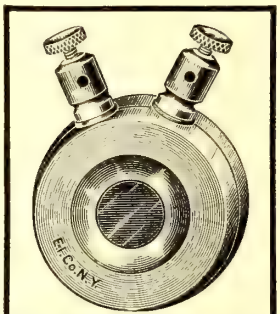


ILLUSTRATION IS FULL SIZE

Our illustration shows the full size of the cell. It is built in form of a watch and is entirely foolproof. There are no screws, no loose wires—nothing to get out of order. The over-all size is 1½"x1¼". The selenium surface is protected by glass and can therefore not be injured, even if roughly handled. The active selenium surface measures ⅜" in diameter—a very large surface and much larger than found in the best cells. The current is supplied to the cell by means of two neat binding posts. The metal case is nickel-plated.

The ratio of these cells is remarkable. Thus a typical cell in the dark measures 96,000 ohms, while if exposed to a 40 c. p. tungsten lamp, the resistance drops to 12,000 ohms. This is a ratio of 8 to 1 which is remarkable and bespeaks of the high quality of the construction. Every cell is guaranteed and we will replace any not giving satisfaction.

IMPORTANT. When ordering state if you wish a high resistance or a low resistance cell.

WE HAVE A LARGE SUPPLY ON HAND. IMMEDIATE SHIPMENTS. ORDERS FILLED WITHIN 24 HOURS.

No. 517 Selenium Cell as described each **$5.00**
By Registered Mail extra $0.12

No. 715 Built-up Selenium Cell (1 Million ohms. Ratio of 30 to 1. Works on 110 Volts) Price each **$7.00**

No. 716 Special Vacuum Selenium Cell. (Resistance can be had from 5,000 to 500,000 ohms.) Price **$10.00**

We Are Sole Distributors of These Cells.

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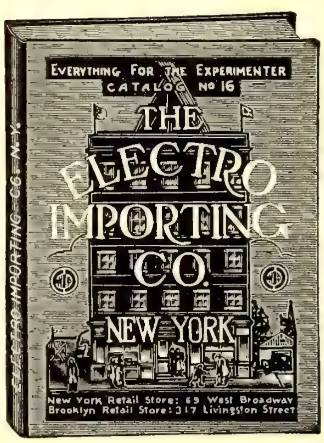
What Catalog No. 16 Contains

It contains the largest assortment of Wireless and electrical experimental apparatus shown in any catalog published. In addition are shown Commercial Wireless Sending and Receiving Outfits, Electric Motors, Dynamos, Flashlights, Medical Batteries, High Frequency Apparatus, Plating Outfits, Toys, Printing Presses, Tools, Sporting Goods and the LARGEST Scientific Book section published. This book will give you as much information as many books that cost you $1.00 or more. It contains 658 illustrations, 2,000 articles, complete Code Chart of Morse, Continental and Navy Codes, sixteen-page "TREATISE ON WIRELESS TELEGRAPHY," list of Call Letters of U. S. Government and Commercial Ship and Shore Wireless Stations, besides a great many useful tables and formulas. This valuable book is 7 x 5¼ inches in size and ½ inch thick, and well bound.

It is sent free for 4c. to cover postage only.



Size 7x5¼"--2000 Articles

Some of the questions answered in Cyclopedia Catalog No. 16:

The Wireless Law of August 13, 1913.
How to Receive Wireless Messages.
How Far You Can Telephone by Wireless.
Wave Lengths of Principal Radio Stations.
How to Erect a Wireless Aerial.
How to Receive Time by Wireless.
How to Photograph Electrical Discharges.
How to Experiment with Spark Coils.
How to Test Storage Batteries.
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There's a Book You Need on Page 378. LOOK FOR IT

QUESTION BOX.

(*Continued from page 356*)

ture or alternating current arc lamps and not on direct current ones?

A. 2. With alternating current there is a tendency for the action of the armature to be jerky or unsteady, and cause the light to flicker. By the insertion of these springs, the vibration of the armature is absorbed, so to speak, instead of being transmitted to the upper carbon, causing both the action of the lamp and the light to be more steady. This jerky feature is absent in the direct current lamps, in which no springs are necessary.

CONDUIT WIRING.

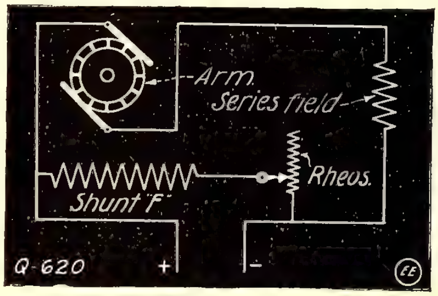
(620.) O. Blassland, Newark, N.J., writes:

Q. 1. How is a flexible conduit installed by "fishing?"

A. 1. It is pulled or fished under floors in partitions, between the floor and the ceiling, by making pockets in the floors, walls, and ceilings, say every 15 or 20 feet, and fishing through with a stiff steel wire called a snake. Thus the conduit is pulled in place from pocket to pocket.

Q. 2. How should armored cable be installed?

A. 2. It should be continuous from outlet to outlet without being spliced, and installed on the loop system. Outlet boxes should be installed at all outlets, but where this is impossible, outlet plates may be used under certain conditions. Clamps should be provided at all outlets and switch boxes to



A Rheostat to Control the Speed of a Compound Dynamo is Connected According to This Diagram

hold the cable in place, and also to serve as a means of grounding the steel sheathing.

Q. 3. Give diagram of connection of a compound dynamo with a rheostat for regulating the current through the shunt winding.

A. 3. The diagram gives the proper connections.

COST OF EXPERIMENTAL LABORATORY.

(621.) Nick Smucyn, Chicago, Ill., wants:

Q. 1. An idea of the cost of an experimental laboratory for chemical and electrical research?

A. 1. You will find some good ideas given relative to a chemical laboratory and the cost of it in the *Experimental Chemistry Course* which started in the June, 1916, issue of The Electrical Experimenter. The cost of an electrical laboratory ranges from a few dollars up to thousands of dollars. It all depends, of course, on what kind of work and its magnitude which you wish to perform in the laboratory.

Usually, if you purchase a fairly accurate voltmeter and ammeter, together with a few ordinary incidentals, you can undertake some worthwhile experiments. A Wheatstone bridge or Ohmmeter will be found very useful in any electrical measurements and tests. A small electric furnace is useful for some work as well as several rheostats, inductances, or impedance coils.

RADIO INTERFERENCE TROUBLE.

(622.) A. B. Rowland, Stuttgart, Ark., asks several antenna queries:

A. In the first place we do not know just exactly the location and arrangement of your antenna. In general, it has been our experience that a simple antenna consisting of but two wires, elevated 40 to 50 feet above the ground, having a length of 250 to 300 feet or more, will do excellent work, especially in receiving.

Again, the antenna should, in all cases, be placed at right angles to all transmission lines carrying commercial light and power currents. If this is not watched carefully there will be observed considerable induction from the antenna with severe interference created by the low frequency alternating currents on the transmission lines. In some cases this effect is so marked that it will entirely drown the signals in the receivers, unless the signals are particularly strong.

A method which has been used successfully to reduce such interference from nearby commercial light and power circuits consists of shunting a very small condenser across the antenna and ground connections before they enter the loose coupler or tuning coil. This condenser is composed of a few small sheets of tin foil, separated by paraffined leaves, the size of the foil sheet being about ¾x1 in. About 10 leaves may be tried, and a greater or less number used, as experience with this arrangement dictates. The size of the condensers will vary of course for different conditions.

With respect to your antenna and the wire for it, we would suggest that all the joints be well made and soldered, for any corrosion on the joint will tend to yield poor results. We advise that you look over some of the complex interference preventer diagrams given in the excellent 25c. book entitled "Wireless Hook-ups" obtainable from our Book Department. Undoubtedly the Marconi or Fessenden arrangement for this purpose will help you. The book mentioned explains both of these connections. Usually the proper arrangement of variable condensers and tuning inductances will eliminate, to a large extent, the sort of interference which seems to trouble you.

BRAUN TUBE REPAIRS.

(623.) Mr. Ralph Batcher, Ames, Iowa, wants to know:

Q. 1. Where he can have a Braun tube repaired?

A. 1. We are glad to know that you appreciated the articles published in a recent issue of The Electrical Experimenter on the Braun cathode-ray tube by Prof. Dr. Ferdinand Braun. The Electro Importing Co. of New York will undoubtedly be able to have the repair made for you if the tube can be repaired at all.

NEW ALUMINUM SOLDER.

A new form of aluminum solder to be applied with a flux has been invented by Mr. Frederick W. Beitz of Peoria, Ill. This solder may be used with a soldering copper and the solder itself contains no aluminum, the inventor claims. Such solders have extensive applications nowadays and prove particularly effective for experimenters' requirements, as it is not always desirable to rivet or otherwise join aluminum parts making up tanks, cylinders and other parts.

STANDARD RADIO TERMS DEFINED.

Approved by the Institute of Radio Engineers.

Under this head we will define the most important radio terms each month. Save them and by pasting each in a book (properly indexed) you will have a handy radio dictionary.

74. *Inductance, Effective of an Antenna:* See Capacity, Effective of an Antenna.
75. *Impulse Excitation:* See Excitation, Impulse.
76. *Interference, Wave (In Radio Communication):* The reinforcement or neutralization of waves arriving at a receiving point along different paths from a given sending station; (to be distinguished from ordinary or station interference, which is the simultaneous reception of signals from two or more stations).
77. *Key:* A switch arranged for rapidity of manual operation and normally used to form the code signals of a radiogram.
78. *Key, Relay:* See Relay Key.
79. *Length, Wave:* See Wave Length.
80. *Losses, Brush or Corona:* See Brush or Corona Losses.
81. *Meter, Wave:* See Wave Meter.
82. *Oscillations (In radio work):* See Current, Damped Alternating.
83. *Oscillator, Arc:* See Arc Oscillator.
84. *Potentiometer:* As commonly used for radio receiving apparatus, a device for securing a variable potential by utilizing the voltage drop across the variable portion of a current carrying resistance.
85. *Radiation, Sustained:* See Waves, Sustained.
86. *Radiogram:* A telegram sent by radio.
87. *To Radiograph (verb):* To send a radiogram.
88. *Radio Telephone:* An apparatus for the transmission of speech by radio.
89. *Radiophone (noun):* A telephone message sent by radio.
90. *To Radiophone (verb):* To send a radiophone.
91. *Rectifier, Electron:* A device for rectifying an alternating current by utilizing the approximately unilateral conductivity between a hot cathode and a relatively cold anode in so high a vacuum that a pure electron current flows between the electrodes.
92. *Rectifier, Gas:* An electron rectifier containing gas which modifies the internal action by the retardation of the electrons or the ionization of the gas atoms.
93. *Relay, Electron:* A device provided with means for modifying the pure electron current flowing between a hot cathode and a relatively cold anode placed in as nearly as possible a perfect vacuum.

    These means may be, for example, an electric control of the pure electron current by variation of the potential of a grid interposed between the cathode and the anode.
94. *Relay, Gas:* An electron relay containing gas which modifies the internal action by the retardation of the electrons or the ionization of the gas atoms.
95. *Relay Key:* An electrically operated key. See further, Key.
96. *Resistance, Antenna:* See Antenna Resistance.
97. *Resistance, Critical, of a Circuit:* That resistance which determines the limiting condition at which the oscillatory discharge of a circuit passes into an aperiodic discharge.
98. *Resistance, Effective, of a Spark:* The ratio of the power dissipated by the spark to the mean square current.
99. *Resistance, Radiation:* This is the ratio of the total energy radiated (per second) by the antenna to the square of the R. M. S. current at a potential node (generally the ground connection). See further, Antenna Resistance.
100. *Resistance, Radio Frequency:* This is the ratio of the heat produced per second in watts to the square of the R. M. S. current (r f.) in amperes in a conductor.
101. *Resonance:* Resonance of a circuit to a given exciting alternating E. M. F. is that condition due to variation of the inductance or capacity in which the resulting effective current (or voltage) in that circuit is a maximum.

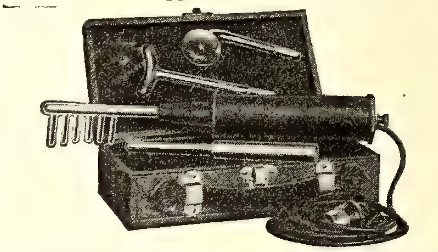
    Note 1: Instead of varying the inductance and capacity of a circuit the frequency of the exciting field may be varied. The condition of resonance is determined by the frequency at which the current (or voltage) is a maximum.

    Note 2: The resonance frequency corresponds the more accurately to the frequency of the free oscillations of a circuit, the lower the damping of the exciting alternating field and of the excited circuit.
102. *Resonance, Acoustic Device:* See Device, Acoustic Resonance.
103. *Resonance, Sharpness of:* See Tuning, Sharpness of.

(To be continued)

A PORTABLE HIGH FREQUENCY OUTFIT FOR THE FAMILY.

While most every day folks do not take kindly to electrical treatment at home, this phase of the subject reverses itself when one is introduced to the numerous merits and really worth-while results to be had from the application of mild high frequency currents. An apparatus known as the *Vi-rayette* has been put on the market for this home treatment of many ailments. It is put up in an extremely neat velvet-lined carrying case and includes a powerful high frequency transformer operating from any electric lighting socket, a surface-comb, external throat electrode, connecting cord and plug.



Practical High Frequency Outfit for Family Use.

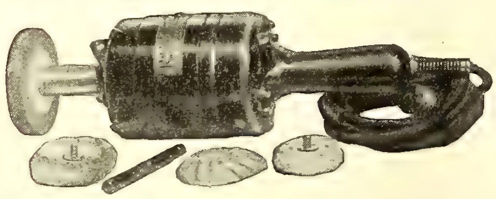
The apparatus in question is capable of yielding excellent results in ordinary and chronic cases, particularly in the treatment of hardening of the arteries, or *arterio-sclerosis*. Many ordinary ills such as head-aches, tooth-aches, intestinal complaints, swollen glands, rheumatic stiffness, muscular fatigue or partial paralysis, et cetera can be very well treated by the patient in the privacy of his own home. It is surprising what beneficial effects will result from applying such a high frequency current for a few minutes daily. It does not breed a "habit" like many deadly patent medicines.

The editor, who was troubled with many abscesses in the ear last winter, found much comfort from one of these apparatus. An abscess which would ripen only in about a week would open in 24 hours when the high frequency current was employed several times a day.

NEW MOTOR-DRIVEN POLISHER.

The Omega High Speed Auto and Brass Sign Polisher here illustrated has a special light built, high speed motor, giving the buff the proper surface speed. It is, moreover, very light in weight making it extremely easily to handle.

The complete outfit is equipped with a 3½x½ grinding wheel, a steel brush wheel for cleaning tires before vulcanizing and two buffs for polishing brass or nickle plate, and has a threaded tapered spindle for attaching the various wheels.



This Motor-Driven Buffer Will Polish Up Your Brass Signs In a Jiffy.

The motors are universal, operating on either direct or alternating current, 25 or 60 cycle, 110-130 volts and other voltages are provided for when the purchaser so desires.

Wireless music has been furnished a company of travelers at sea. The next great invention should be musicless neighbors in flats. What?!!

THE MYSTERIES OF ULTRA-VIOLET LIGHT.

(*Continued from page 311*)

by aliniation with cross wires in the telescope and checked up the following day from the *Nautical Almanac* by laying off their orbits on a drawing board."

While the planet Saturn has nine moons, only four of these could be shown on our front cover. The other ones are so far away that they fall beyond the edges of the magazin The four moons are shown as white dots silhouetted against the sky.

Another family of the Ultra-Violet rays is the Infra-Red rays which have a longer wave length. Their velocity is considerably less in comparison with that of the ultra-violet. Although very little research work has been done with this subject, it may be of interest to the reader to see the effect of the Infra-Red rays on a photographic plate. Fig. 6 shows a group of trees in a park in Florence, Italy, taken by infra-red light.

As will be noted a curious result is obtained. The sky is pitch black while the trees are white. All shadows are black, however. This photograph was made with an ordinary glass lens but a color filter, absorbing all other rays, including the ultra-violet ones, was used.

ELECTRICITY, THE MYSTIC IN MODERN HOTEL SERVICE.

(*Continued from page 313*)

and the chief picks up pass keys opening any door in the hotel.

Besides the telephone system, this hotel has an electric thermostatic fire alarm working automatically in each room and corridor. These announce the fire and the point of incipiency to the Fire Captain. Again there are provided in all corridors square brass boxes containing a small illuminated electric bulb. On the bulb appears the notice "Break glass for Fire Department." A tiny hammer hangs beside it for the purpose. When the bulb is broken it causes an electric relay, with which it is in series, to operate fire alarm bells in the engine room and simultaneously reveals the number of the circuit, so that the exact location of the fire is known to the Fire Captain. More wonderful, still, is the fact that various sections of any floor can be quickly isolated or shut off so as to confine the conflagration by simply throwing in certain switches at the telephone switchboard. These control magnetic release hooks attached to certain doors throughout the building.

Other conveniences found in every room are of course the telephone, which may be used at once simply for house calls, connection with the Clerk, or for outside long-distance connections; electric reading lamps secured to each bed, night lamps of low candle-power for the use of those guests who prefer to sleep in a semi-dark room; electric fans, etc. Ice water is always available in these modern hotels without depending on that immortal, time-worn nuisance of punching a button three times and sometimes twenty-three before the thirst-quencher finally appears, in his right hand the ice water pitcher, in his left your awaiting dime! This ice water is filtered, softened and distributed by electrically operated machinery located in the basement and comes under the charge of the chief engineer.

Some hotels also have a number of refinements involving the use of electricity such as curling iron heaters, electrically heated pads which may be used for attacks of cold feet and back, and electrical shaving mug heaters.

As the fiction writers have it, the way to a man's heart is through his stomach. Acting on this suggestion, let us see how the Chef performs his wonders. The gastronomic seat of all hotel life is, of course, in the kitchen. Here it is that the famous French, Hungarian, Bulgarian (and don't forget the spaghetti experts) Italian Chefs hold forth in all their glory of Vandyke beards and white linen caps. Some idea of the enormous amount of help employed in up-to-date hotels may be gleaned from the fact that the Hotel Biltmore in New York City employs constantly about fourteen hundred people, which includes waiters, kitchen attachées, chambermaids, valets, bellboys, ad infinitum. Electricity is truly a wonderful genii in this department, from sawing apart a whole side of beef or a loin of chops, up to the motor-driven dishwashing machine which cares for the mountains of soiled dishes. In the preparation of the food many electrical machines, some of them specially designed, help the good work along, such as meat choppers, cutters and grinders, egg beaters and boilers, coffee grinders, cream whippers, dough mixers, ice cream freezers, ice crushers and cubers, silver plating, polishing and buffing machines, potato peelers, lemon squeezers and so on down the line. In many cases cooking is done either partially or entirely by electricity. This form of range is one of the latest, and has proved very satisfactory, as the heat may be regulated to a nicety with corresponding effect on the treated delicacies.

The method of handling the dining-room service is of paramount importance as might be supposed. At the Hotel Biltmore, for instance, there is an extremely efficient arrangement in use for this purpose. The main dining-rooms on the lower floor are in close proximity to the kitchens, so that the waiters may gather up their dishes directly. However, for the Roof Garden restaurant and individual room service, there is supplied a series of eight large dumbwaiters, which are the nearest approach to the human specimen that the author has ever come in contact with.

Suppose a waiter on one of the upper floors wishes to place an order for a certain dish or dishes in the kitchen below. All he does is to write out the order for the desired victuals on his telautograph, which order is reproduced on a companion instrument before the Chef's staff. When the dishes are ready they are placed on one of the eight dumbwaiters and the minute its door is closed it is automatically shot roofward. Just before closing the door, however, the kitchen attendant inserts a plug in the box mounted alongside the dumbwaiter door, each plug hole corresponding to a certain floor number. After this is done the dumbwaiter automatically takes care of itself and will stop at the proper floor without any further attention. When it reaches its particular floor, an alarm rings and the waiter knows that his order has arrived. Again, when a door on the upper floor is opened, the dumbwaiter is automatically locked, and cannot be tampered with by anyone else until this door is shut, when it once more automatically returns to the kitchen.

As just mentioned, the telautograph plays a very important part in the ordering of dishes between the waiters and the kitchen, but in many instances there are supplied speaking tube service and telephones. At the Biltmore, one of the very latest telephone systems has been installed throughout the kitchen, operating on the Turner Dictagraph principle. These 'phones are of the loud-speaking type and orders can be heard twenty feet away. In like manner the Chef may answer the conversation

without stepping close to the instrument or jamming the receiver half way through his outer ear.

The problem of clean linen is always one of supreme importance in such hotels, where the large laundry is constantly in operation in consequence thereof. All the machinery in the laundry is of course electrically driven, including the washing, wringing and drying machines, also starching machines, electric irons, fluting machines and electrically heated mangles. A motor driven conveyor system carries the finished pieces to the linen room at the Astor.

The maid system in use at modern hotels is a great time saver. Instead of having to hunt through half the rooms on a floor to locate the room in which the maid is working, one has now but to glance down a corridor and a small illuminated electric globe marks her position at once. Moreover, when she lights the signal lamp in the hall alongside the door of the room in which she is working, this fact is registered on an annunciator downstairs. The "drop" corresponding to the room number falls and hence the Bell Captain knows just where each maid is at any instant, and if any particular maid takes five minutes longer to straighten out the room than thought necessary—well we leave that to your imagination!

Elevator service is of course of the best and as many as twelve *guests'* elevators alone are in use in some of the large hostelries. These are invariably equipped with some form of indicator over the door on each floor, which shows always at just what floor the cab is located in its travel. At the Astor a progressive lamp annunciator is placed on each floor, the tiny lamps lighting and extinguishing successively so that one may actually "see" the car rise and descend from floor to floor. Most of these elevator cars are also equipped with telephones for emergency purposes, are electrically lighted and have an electric flash lamp annunciator, on which appears a lighted bull's-eye corresponding to the different floors calling while the car is in motion. Also there is a diminutive fan, very essential on a hot day.

When it comes to entertaining it may safely be said that the first-class hotels of to-day are a whole show in themselves. At the Hotel Astor, for instance, there is one of the finest roof gardens imaginable. This is electrically decorated in a highly artistic manner with thousands of electric lights and numerous electric fountains. The grand ballroom at this establishment is one of the finest and most beautifully illuminated in existence. The various side lamps and chandeliers about this palatial enclosure may be controlled when desired by remote control dimmers operated from various points about the room, thus giving any degree of illumination desired. Besides, there is a marvelous electrically operated concert organ capable of producing music of wondrous volume. A portion of the mezzanine floor at the south end of the grand ballroom can be raised and lowered to form a platform or stage whenever desired. Foot and border lights are arranged the same as on a regular theater stage. This magnificent room is thus adapted to many purposes.

At the Biltmore the roof garden idea has been carried to wonderful extremes. One of the most beautiful innovations ever effected in a hotel dining-room is that where "The Cascades" are in operation. Here a multi-step platform constructed entirely of plate glass is built; under the glass plates are several hundred electric lamps of various colors, while an electrically lighted fountain surmounts the entire arrangement. The water flows from the fountain

downward over the illuminated glass steps, while the orchestra is located around the fountain. This combination is well calculated to please both the eye and ear of any pleasure-seeking connoisseur.

Electricity, the ever present servant, is thus seen to be at the beck and call of whosoever may care to pay the price. As an example of what some of these entertainment features cost, it may be mentioned that one of these modern palaces expended over $15,000 just to install an electrically operated ice plant in one of its smaller aerial gardens, so as to freeze the entire floor space firmly and thus provide a skating rink for the use of its guests!

Some of the miscellaneous features of interest to the electrician are the electric carriage call, motor driven vacuum machines for sweeping, floor scrubbing and polishing machines, watchman's clock system, electrically synchronized clock system, electric signs used for advertising, et cetera.

The Astor has a unique advertising feature in the form of a flag, which flutters in the beam of a powerful searchlight mounted on the roof. This lamp consumes 1½ kilowatts.

And after you have paid your bill you make your way to the large revolving door at the entrance of the Astor. According to time-worn custom, you brace yourself to revolve that door, mule-like, as you do back home in your office building. But not so here. For this particular door has a one-eighth horse-power electrical motor hitched on to it and just when you reach it an attendant, who does nothing else, pushes a button and the door revolves as if by magic. Flabbergasted at this trick, you find yourself on the steps while the "starter" already beams at you with: "Taxi ready, sir!"

KILLING SHARKS BY ELECTRICITY.

(Continued from page 314)

from the reel at rest. A slight pull at the cable, however, immediately sets the reel revolving and the breaker C, with its contact B, now makes contact with the ring-shaped piece A. This is connected to the mains of a small 220 volt alternating current dynamo giving about five amperes. The other pole is "grounded" (connected) to the boat's outside metallic plating. Now salt water is an excellent conductor for the electric current and the circuit will naturally be closed very effectively by way of the sea and the shark's body and from there through the bait cable, back into the dynamo.

Thus it becomes evident that the full current strength of 1,100 watts must pass through the shark's head once he has the bait in his jaws. Nor can he let go as the jaws will set like a vise due to the paralyzing action of the powerful current. As the shark is entirely immersed in a first class conductor—salt water—and his wet body is almost as good a conductor, the conditions for his electrocution could indeed not be more ideal. In less than ten seconds he must have been shocked to death, particularly because most of the current has passed directly through his head. As he swirls around in his death agony more cable is played out and the reel spins around as it does so. This causes the circuit breaker to open and close the current a number of times in quick succession, which is desirable, as it gives the shark powerful shocks impossible of being withstood even by a whale.

If another shark lurks around and attacks his electrocuted brother—as sharks are wont to do—his fate is likewise sealed. In all probability he will be electrocuted too.

After the shark has thus been killed, an attendant turns off the current and winds

up the reel; the has-been man-eater can then be hoisted up and dismembered as is the seaman's fashion. The pieces can either be thrown overboard or else can be used as bait to catch the next sharks. The latter is a good method, for shark likes shark.

In case the bait cable should break during the shark's death convulsions, no harm is done, as he is probably dead by that time and the purpose is accomplished. And cable is cheap. Apparently, this plan should be readily accepted by municipalities along our shores, particularly by seaside resorts whose greater income depends on the bathing public. A few dozen of such electric boat patrols would quickly rid our shores of these pests at small expense. The boats we have already; practically the only item of any consequence is the dynamo. This can be had for about $86.00. The reels manufactured in quantities should not cost over $15.00 apiece. Three deck-hands would be sufficient to kill a hundred sharks a day.

Of course, it goes without saying that this scheme is applicable to bays and inland creeks as well. In this case the shores of the shark-infected river can be equipped with a number of reels stationed at intervals. One fair sized dynamo-generator can take care of practically any reasonable amount of reels, as it is unlikely that more than one shark will be electrocuted at the same instant.

The beauty of this scheme is that it is almost entirely automatic and needs but little attention. Nor are the sharks frightened away as by useless dynamiting and shooting. By running the generator during the day and especially at nights, maximum efficiency can be obtained and it should be only a number of days before the last shark is killed. It is also entirely feasible to suspend the bait a few feet under water, simply by adjusting the reel as desired. No current is passed through the bait in this position till the shark gives a strong pull at the bait line, which closes the circuit as explained above.

True, this latter method will undoubtedly kill other fish too (if they should have escaped the sharks), but the means justify the result and its accompanying small losses.

The writer is aware of the fact that shark experts will call the proposed scheme unfeasible. They will say that sharks are far too timid to come so near a moving vessel. In answer, let us quote Mr. Chapman Grant of the New York Aquarium staff. In a recent interview this expert said:

"Shy as it is, the shark will not hesitate to attack whatever its size can cope with, if hunger drives it. That shyness is excessive. There are times when they will snatch at anything that is white and gleaming; thus a white bone or a metal jig is enough of an invitation to their mighty teeth.

"I have caught them myself that way," said Mr. Grant. "I have caught them 'way up rivers, too. Up the Tammassee River, for example, a good distance from Tampico. I have known them to be caught at the farther end of a chain of five lakes. There is absolutely no grounds for the theory that sharks will not inhabit fresh water. They will go anywhere, if their hunger leads them there. They have been caught in Venezuelan lakes and in lakes of India. And sharks are the most temperamental of creatures. One day they will be ready to strike boldly at whatever crosses their path; the next day they will flee in nervous fright from the least of things that moves. It depends almost entirely upon one cause—hunger."

Are you a regular reader of the "E.E."? If not—Why not?

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on. No attention given to unsigned communications.

HIGH FREQUENCY INTERRUPTION.

(88.) W. J. Madole, Washington, D.C., writes as follows:

"Kindly advise in reference to practicability and patentability of following described apparatus for producing high-frequency electrical current interruptions for radio purposes:

"(a) A selenium cell in a circuit to be interrupted; a strong beam of light focused on this cell.

"(b) A means for rapidly interrupting this beam of light, possibly in the shape of a wheel of flat disc-like form with narrow slits or light openings spaced around the periphery, this wheel revolving between the source of light and the selenium cell in such a position that the light will reach the cell through the above said slits or light openings. A wheel of say 36" diameter, having 1,000 such light openings around the circumference, revolving at 3,600 R.P.M. or 60 revolutions per second, would produce a frequency of 60,000 per second. Size of wheel, speed, number of openings, etc., could, of course, be varied."

We think this idea has been tried before, however, without much success. There is such a thing as lag in the operation of a selenium cell, which prevents their acting if the light is interrupted at too high a frequency. The inertia of the selenium cell is too great, for it takes a certain amount of time before the selenium in the cell becomes a conductor and before it becomes a non-conductor again. This time element is quite considerable, and to our knowledge there are no cells that would be able to produce a frequency of 60,000 per second; at least we have never seen a cell that could do this.

INSULATOR.

(89.) Harry Bremer, of Jersey City, N.J., has submitted to us an insulator to be made of glass or porcelain, and, instead of using wood or iron pins, which decay or weaken, our correspondent proposes to make the entire insulator in a certain manner entirely out of glass or porcelain. Mr. Bremer wishes to know if the idea is practical, and whether a patent could be obtained on it.

While the idea certainly has some novel points, we doubt very much if a patent could be obtained on it. There are so many patents on insulators at the present time that it would be necessary for a patent attorney to make a search in the Patent Office, and we would advise you to do so. As far as practicability goes, the insulator is entirely practicable to our minds as long as it concerns a small insulator, not more than 3" high. If the insulator is made very large, we believe the cost of making it entirely in porcelain would be prohibitive, and, moreover, it seems that the pin shank would be weak in proportion to the size of these larger insulators.

MOVING TOY.

(90.) Daniel E. Sullivan, New York, N. Y., has submitted a very clever drawing of a moving toy in the shape of a tramp being chased by a dog, both figures moving at the same time. He wants to know if a device of this kind is patentable, and whether commercially feasible.

This is a very good idea, and we have no doubt that a patent can be obtained upon the idea at the present time. Due to the shortage of toys from Europe, a device of this kind should prove of distinct advantage to an American manufacturer, and a great many articles such as these are in wide demand. Our advice is to get in touch with a patent attorney.

COLLISION PREVENTER.

(91.) John T. Dwyer, North Philadelphia, Pa., sends in a very lengthy description and drawings of an ordinary direction signal, which he claims should prevent rear-end collisions on railroads. The underlying idea is to use two tubes, containing a partial vacuum, in connection with a relay which in turn would give the alarm and thus warn the engineer in his cab. The vacuum tubes are supposed to be connected in shunt with one of the axles of the locomotive.

This scheme is entirely unfeasible, for the simple reason that not enough current could be forced through the vacuum tubes. It would be necessary to have at least 1,000 volts potential to pass a current through a tube of this kind. This, of course, makes the scheme entirely impractical. If another means instead of the vacuum tubes can be substituted, the device might work, although we have our doubts.

SPARK WIRELESS TELEPHONE.

(92.) E. M. Bailey, Woodsdale, N.C., sends description and drawings of a *spark* wireless telephone which presents some new features. He proposes to control the dynamo by means of a heavy current transmitter. Our advice is sought on this arrangement.

We must discourage all *spark* wireless telephone schemes, as they have all proven uniformly unsuccessful so far. Any wireless telephone using an ordinary spark gap and spark coil, unless some entirely new and as yet unknown device is used to change the spark characteristics, will not work. The interrupted spark note interferes with the working, and speech received can never be clear.

TELEPHONE SERVICE IN HAWAII.

The total value of the plant of the Mutual Telephone Company which controls the automatic system in Honolulu, Hawaii, is $891,502; operating and general expenses last year were $161,483 and income $290,450. The income for 1914 was $264,095. There are bonds outstanding amounting to $260,000.

FOUR WATERFALLS COULD TURN ALL WORLD'S WHEELS.

If some clever electrical engineer will invent a system by which electric power can be transmitted over wires to a distance of from 6000 to 8000 miles without serious loss, the world need not worry about the possible or probable exhaustion of its coal and oil (it has been calculated that these will be exhausted within one hundred years if the present rate of increase of consumption continues), for there are four waterfalls that can supply far more than enough power to turn all the wheels in the world. These are, Victoria Falls of the Zambesi, our own Niagara, the La Guayra Falls of the Parana River, and the Iguassu Falls of the Iguassu River, both of the latter close to the frontier of Brazil and Paraguay.

The total horsepower derived from burning coal and oil, direct and indirect, is more than 30,000,000 in the whole world.

The Victoria Falls is alone capable of furnishing 35,000,000 horse-power.

Iguassu Falls, it has been estimated by an Argentine engineer, can supply at least 10,000,000 horsepower.

La Guayra Falls can furnish about 12,000,000 horsepower.

United States Government hydrographers calculate that the streams and rivers of the United States are capable of giving 230,800,000 horsepower.

The difficulty in the way of utilizing the giant falls of the Zambesi, the Parana and the Iguassu is that they are all from 600 to 800 miles from the points to which it would have to be carried, and almost trackless wilderness lies between.

Here then is a problem worthy of an Edison, a Cooper-Hewitt, a Marconi, a Tesla or a Pupin; a task that, solved, will earn for its sponsor, an undying fame.

$25.00 to Anyone Who Solves This Electrical Problem

In the belief that the description, explanations and requirements printed in the August issue were not clear and that this is the reason why we did not receive more replies, we therefore reprint here additional desideratum:—The problem to be solved is as follows:

The steel bar B, (refer to drawing in August issue) must be attracted by the electromagnet A at a speed of from 10 to above 50 times per second. B is held back by a spring and it requires about 5 lbs. pull by the electromagnet A to be operated. The distance from B to A, normally is $\frac{1}{4}$" and when B is attracted by A, it stops 1/16" from the electromagnet, so that the net distance traveled is 3/16". The electromagnet A, because of lack of room, cannot be above $\frac{1}{2}$" diameter and $2\frac{1}{2}$" length, unipolar design, with solid, Norway iron core, $\frac{1}{4}$" diameter. The device that produces the vibration of B should be so arranged that it will be possible to set it for a certain frequency of pulsation, from 10 or less, to 50 or more per second, and once set, it should not require other adjustment for at least 6 months.

Good results have been obtained by using an interrupter like the one illustrated in the August *E. E.*, but the great drawback is that, in order to obtain the required pull from A it was necessary to use 24 volts and 6 amperes of D.C., and such a high current produces an arc from the electrode D to the carbon electrode E, causing the electrodes to wear out in a short time, and moreover, requiring careful readjustment every few days. A commutator cannot be used as such systems are already patented. Mercury cups or oil baths and magnetic blow-outs are not practical. You can either improve the interrupter or entirely redesign it. The current to be used in operating it can be D.C. or A.C. (D.C. preferred) at from 6 to 110 volts.

Our subscriber is willing to pay $25.00 for the best suggestion that shall prove acceptable, made by any reader of THE ELECTRICAL EXPERIMENTER who can solve the problem for him. The offer is absolutely genuine and the contest will be conducted as follows:

There will be a board of four judges as follows: Two of the editors of THE ELECTRICAL EXPERIMENTER will constitute one side, while our subscriber and another engineer will constitute the other side. This Board will read all letters and suggestions and will select the most satisfactory answer. The result will be published in a coming issue of THE ELECTRICAL EXPERIMENTER and the winner is to receive $25.00 at once at the close of the contest.

The party who is to receive this information from any of our readers (if it is satisfactory) becomes the sole owner of the idea. It is not necessary to offer any experimental evidence as to the working qualities of the proposed circuit or mechanism, but as long as the device or suggestion made to him is entirely *practicable* and *feasible*, a prize of $25.00 will be paid the successful contestant

The suggestions and drawings must be made *clearly* and *concisely* and the exact size of the various parts, if drawings are forwarded to us, must be also given, so that we shall be able to form quickly the best opinion as to the working qualities of the individual suggestions.

All communications should be addressed to "Editor, Interrupter Contest," and the following rules should be observed.

Sheets should be written on one side only.

No pencil writing acceptable.

Drawings must be on a separate sheet; all drawings to be in pen and ink.

In case the idea proves acceptable to our subscriber propounding this problem, he, on payment of $25.00 for the idea, immediately assumes control of the device as well as all patent rights belonging thereto. The sum of twenty-five dollars has been deposited with the Experimenter Publishing Co., to be paid over to the winner. The contest closes September twentieth and no letters will be considered after that date.

THE TELEPHONE IN MODERN WARFARE.

(*Continued from page 315*)

second field artillery at Fort Meyer, Virginia, giving orders to a group of gunners, at a distance, by using this ingenious and efficient little military telephone-telegraph outfit. The complete instrument is supported by a leather strap which is held on the operator's neck. This gives him one free hand to operate the telegraph key. The knob of the key is also enclosed in the case, but at the point where the key knob is located a fine flexible leather is placed over the case, so that it permits the operator to depress the key with great ease.

The wire seen hanging from the case in Fig. 4, is used as a line between the observation officer, and the officer who is in charge of the gun crew, Fig. 5. When telephonic communication is required, the cover supporting the telephone transmitter is raised from its position until both back springs clasp two notches; this automatically connects the transmitter with the telephone current, and disconnects the key from the telegraphic side. The loud-speaking telephone is automatically connected in this line ready for duty. This method of receiving orders from a distance without wearing head 'phones, is, of course, highly advantageous, and the incoming vocal sounds are so loud, that the sounds accompanying actual warfare conditions do not interfere with the conversation.

The complete unit is substantially built and all the instruments are rigidly mounted in a heavy leather case, which only weighs about four pounds.

Most of us are aware of the fact that conversation between persons in an aeroplane traveling at a speed of 100 miles an hour is extremely difficult, due to the rapid air currents and engine noises.

This problem of improving such conversations on aeroplanes has been taken up extensively by the different nations of the world, which found that the *telephone* is the best suited for the purpose. Several types of instruments have been developed during the past few years, some of which have proven a total failure. These have been tested in actual service in Europe, while others that are being used are not as satisfactory as they might be. However, as they cannot obtain any better ones at the present time, they are forced to use them. The same company that has developed the portable military telegraph-telephone outfit for artillery requirements, has recently developed an excellent aeroplane telephone, which is, perhaps, the most successful ever designed. It is illustrated at Fig. 6.

The telephone transmitter is of peculiar design, and is so supported in a frame that it can be regulated to suit the operator. The microphone itself is of rugged construction, in order to withstand rough usage. The two straps of metal supporting the transmitter are used also as conductors for the instrument. They are properly insulated on the transmitter back. The receiver is located on the top of the helmet and is covered with leather so as to protect it from outside damage. The sound produced by the receiver is conveyed through two conical horns, to the ears of the operator. The large opening is indicated in the photo by the extended leather channels on the side of the aviator's ears. The ears are protected by soft leather padding, which at the same time exclude external noises. With this ingenious scheme of employing two conical horns the sound is so immensely amplified, that all other noises are drowned out. The electrical connections are made with a double flexible conductor, having a plug on each end. The plug is inserted in a special jack re-

(*Continued on page 374*)

ELECTRICITY DIRECT FROM SUNLIGHT.

(Continued from page 317)

the detail view of the cell here reproduced.

A partial explanation of the "illumination voltage effect" may be interesting along the lines observed by Professor F. C. Brown, in some papers on light-sensitive selenium.

The idea is that light lowers the stability of certain electrons in the copper oxide crystal structure. As a result the electrolyte absorbs these electrons of low stability and the back plate in turn absorbs the electrons from the electrolyte. Or the electrolyte acts as an intermediary to continually transfer the unstable electrons from the illuminated plate to the dark plate.

The *electrons* travel away from the copper oxide in the electrolyte and from copper to copper oxide in the external circuit. The flow of current is from the front plate, along the connecting wire to the rear copper plate.

The electrolyte serves rather as an equalizer and probably to make copper oxide. The polarization observed is very likely the same as that observed in ordinary batteries. The electrons travel through the electrolyte on electrolytic ions and probably collect on the back plate as gas bubbles, etc.

It is of interest to compare the efficiency of the new illumination battery to that of a corn crop, as very conservatively estimated by Prof. F. C. Brown:

A plate 22"x29"=4000 sq. cm.—

which probably received about 1 cal. (calory) per sq. centimeter 1 minute on a clear day.

Energy received equals 4000x1=4000 cal./min.

$$\text{Energy received equals } \frac{4000}{60} \times 4.2 = 280 \text{ watts.}$$

Energy output=volts x amperes:

$$.1 \times .2 = .02 \text{ watt.}$$

$$\text{Efficiency} = \frac{.02}{280} = 7 \times 10^{-5} = .007 \text{ per cent.}$$

The mechanical efficiency of land devoted to the production of corn, on the assumption that the corn is fed entirely to the most efficient work animals.

Mechanical work to be obtained from every sq. cm. of soil is:

$$\frac{\text{bu. per acre}}{\text{sq. cm. in area}} \times \text{net lbs. in bu.} \times \text{cal. per lb.}$$

x efficiency of horse equals

$$\frac{50 \text{ bu.} \times 50 \text{ lbs. net} \times 1.6 \times 10^6 \text{ cal./lb.} \times .30}{4 \times 10^7 \quad 2} = \frac{30 \text{ cal.}}{\text{cm.}^2 \text{ yr.}}$$

Amount of energy received from same per year=

$$390{,}000 \frac{\text{cal.}}{\text{cm.}^2 \text{ yr.}}$$

Efficiency of land is

$$\frac{30}{390{,}000} = 7.7 \times 10^{-5} = .0077 \text{ per cent.}$$

Thus the mechanical efficiency of the cell just described compares favorably with the best land, under the sun's energy, so far as the mechanical output is concerned.

Finally two theories suggest themselves by which the action of this cell may be explained:

1—The electronic theory;

2—The chemical theory; namely, that the front plate, or contiguous liquid layer, undergoes chemical change, under the influence of light, which causes a flow of current.

At present, the evidence seems to point rather to the electron theory as the conditioning agent, and the chemical theory as a secondary effect and not the primary.

THE DAWN OF ELECTRICAL RAILROADING.

(Continued from page 318)

ure is attached to the famous *Olympian* flyer and is on its way crossing the great Continental Divide. The total locomotive equipment includes forty-two units, each one of which costs about $112,000 to build. The weight of the single locomotive is 284 tons and it is capable of hauling a 3,200 ton load up a one per cent grade at a speed of sixteen miles an hour. Similar electric locomotives geared for higher speed will haul an 800-ton passenger train over the same stretch of road at a velocity of sixty miles per hour.

Compare for a moment this monster electrical speed demon, with the wood-burning locomotive of half a century ago, weighing less than twenty tons, with a tractive power not exceeding 5,000 pounds. The highly perfected Mallet steam locomotive of the present day exerts a tractive power of 76,200 pounds, while the monster electric locomotive in use on this wonderfully developed road weighs 284 tons apiece with a tractive effort of 85,000 pounds. These locomotives measure 112 feet 8 inches in length and are driven by separate, direct current motors twin-geared to each of eight pairs of driving wheels. The cab extends nearly the whole length of the engine.

In the general operation of the system many unique features are brought into play, some of which have never been used heretofore, at least to any great extent. One of these features involves what is known technically as *regenerative braking.* This covers a method used on down grades on each train instead of consuming electrical energy, and actually produces it while traveling, and at the same time the speed of the train is kept under perfect control.

This follows from the fact that electric motors are reversible in their functions, i.e., while they absorb electrical energy and give out mechanical power, when ascending grades, they can, moreover, perform the reverse of this operation and absorb the mechanical energy resulting from the down grade travel of the train, due to gravity, and transform it into electrical energy. Thus these electric locomotives provide a perfect braking system which is independent and separate from the usual compressed air brakes, these latter being used only in emergency and for stopping trains. Further, this electrical energy when generated is returned to the trolley wire to assist other trains and thus produce an amount of electric current which is actually utilized and which, of course, costs a certain amount of dollars and cents for every watt and kilowatt consumed.

In actual operation at the crest of the grade the helper or (pusher) locomotive is brought to the front of the train and coupled with the forward locomotive, both being operated as a single unit. The train is then controlled on the down grade by braking. This system of electrical braking provides maximum safety, it is claimed, and besides it eliminates excessive wheel brake-shoe or track wear as well as overheating. It moreover insures uniform speed on down grades and returns electrical energy to sub-stations which can be utilized by other trains—from 25 to 52 per cent of power is actually recovered in this way.

It is only a matter of time, and it really seems a very short time, before electrical energy for railroad work will receive wide-

spread acceptance for a number of pertinent reasons. One of these is efficiency, as applied in an over all sense, and which as every engineer knows, spells either profit or loss, depending upon the balance between the net earnings of the system, be it large or small, and the net cost of upkeep or maintenance.

As a matter of fact a large sized high voltage hydro-electric project, such as the one described above, will realize in many instances an over all efficiency considered from the water-fall to the locomotive driving wheel of 55 per cent. Compare this with the efficiencies attained on any modern steam railroad. The best authorities state that a steam locomotive, when operating under the most favorable conditions with regard to speed, load, grade, etc., does not exceed a gross efficiency, from the pounds of coal burned in the fire box to the driving wheels, of 12 to 15 per cent. Some railroad authorities claim as high as 18 to 20 per cent. efficiency for steam locomotives of the latest compound type, with steam super-heating apparatus, but it seems very doubtful if such a value is actually attained in practice. The efficiency of the electric locomotive is very high, ranging from 80 to 90 per cent. Judging from past performance in this direction, it seems fully evident that electricity in its application to railroad transportation problems has come to stay.

TIMING THE FREQUENCY OF MUSICAL AND VOCAL SOUNDS.

(*Continued from page 320*)

prevailing conditions of fusion, and also that they shall be widely enough spaced in both directions to be easily read. It is also essential that a single little sensitive flame shall light up the whole exposed surface of the screen.

A fundamental requirement in this principle of measurement is that the light shall be made intermittent through the action of sound waves. This may be accomplished in various ways. In the simplest arrangement an ordinary manometric capsule is used, and the singer holds a funnel before his mouth in such a way as to effectively collect the vibrations. Acetylene gas supplied by a motor-cycle tank is used for this sensitive flame.

While this mechanical transmission through a manometric capsule is for most purposes the simplest means, and is entirely satisfactory, especially in singing, we have electrical devices that have distinct advantages. The receiver of a microphone may be converted into a manometric capsule by building a gas chamber on the ear side and supplying it with a gas inlet and a jet nipple. The vibration of the receiver membrane controls the gas

flame in the same way as in an ordinary capsule. The microphone transmitter is used with this as in ordinary speaking. The best type of commercial instrument that may be readily adapted for this purpose is the Phonette or the Acousticon.

While the electrical apparatus may be a little more delicate to handle it has the advantage that it is more sensitive and can be used for the recording of a tone which would not be strong enough to register in any other way. It also makes it possible to set this apparatus in front of the singer so that he may sing for a record without being aware that a recording instrument is present in the room. The singer may be isolated in a quiet room or in familiar surroundings, in order not to be disturbed by the presence of another person and the main instrument. The measurement may even be made at any long distance covered by telephone connection, as all that is necessary is to put the microphone transmitter in front of the singer at one end of the telephone line, and connect it with the microphone receiver on the tonoscope at the other end.

Under the same circumstances a vacuum tube may be used in place of the gas-flame capsule. The intermittent light is then caused by the interruption of the current in the primary circuit of an induction coil which has the vacuum tube in the secondary circuit.

The stroboscopic reading requires fairly complete darkness. To avoid darkening the room a hood (not shown in the figure) has been built to fit over the reading surface of the tonoscope. This hood forms a dark chamber and the inner surface, being bright, serves as an excellent reflector for the light. For intensive reading at a given point on the scale, a small sliding hood is made on the same principle. It has the advantage of centering the light upon the point of reading in the scale. A reflecting mirror (not shown in the figure) is used to distribute the light over the visible portion of the screen for ordinary use.

To obtain musical notes from the tonoscope the siren blow-pipe is connected with a compressed air tank or it may be blown directly by a mouth tube. A speaking tube is used to carry the sound to the observer's ear and the opening and closing of this tube by means of a clamp starts and stops the sound.

The siren tone is not a tone of good quality. But a beautiful tone may be produced by projecting a beam of light through the holes in the screen upon a selenium cell in circuit with a telephone receiver. It so happens that the fluctuation in the resistance of the selenium cell takes approximately the form of a sine curve, and that produces a tone of most remarkably clear and smooth timbre in the receiver. One may, however, use any sort of instrument for giving the standard tone, as the pitch of the instrument can be read off on the tonoscope at any moment.

The reading is simple and direct. The first task is to see which row stands still, or the nearest still. This row indicates the desired record and will be seen irresistibly the moment the tone is produced, because all other rows are blurred or in rapid motion.

The tonoscope furnishes us the first ready and, at the same time, reliable means of measuring directly the pitch of a tone as sung, spoken, or played with a musical instrument. Heretofore, graphic recording has been the only reliable method. This has the merit of accuracy but is entirely too indirect and laborious to be of general use in practical work. As we have seen, it registers the tone as sung or played under natural conditions, and the record is simultaneous with the tone. The scope of its usefulness is therefore very great. It furnishes us an approach to countless problems both in pure and applied psychology. The psychology of tonal expression is a field practically unworked as compared with the psychology of the appreciation of tone, largely because we have not before had any convenient means of measurement.

The settling of disputed questions of pitch has been interesting. For example, there was a pitch discrepancy in the playing of the oboe and the French horn in a symphony orchestra. Each player was given an opportunity to register a specific tone in the tonoscope, and it was found that the oboe was playing consistently 1.5v.d. flat. A vocal soloist had a tendency to flat relatively high notes. She observed the error and learned to make the right correction. A singer was practicing to eliminate an undesirable fluctuation of the pitch of the voice and was much helped in practicing before the tonoscope as before a mirror.

There is a conspicuous place for the tonoscope in the musical conservatory. The ear of the singer or player is too generous because it seldom has any objective correction. The pupil persists in constant errors becouse there is no objective check on the ear. But the tonoscope does for the ear what the microscope does for the eye. It magnifies and objectifies to the ear, bringing out even small details of the pitch of the tone.

An actual experiment in training of the voice by the use of the instrument revealed among other facts the following: A group of six singers practicing daily for twelve days, part of the time with the instrument and part of the time without it, showed that the average result of training with the instrument was superior to the average result of training without it, by forty-two per cent. in the ability to strike a tone, by fifty-five per cent. in the ability to sing musical intervals, and by twenty-six per cent. in the voluntary control of the voice in sharping or flatting; and the ability gained by virtue of the aid of the instrument was transferred in large part to ordinary singing.

THE UNTERRIFIED AMATEUR.

(*Continued from page 325*)

ought to be on the inside of a closed glass bulb, and is on the outside; it is distinctly annoying.

However, to make a long story short, eventually the bulb was done. It was not beautiful; I would say it looked like a diseased potato, only I hate to hand an insult like that to any honest tuber, especially an unfortunate one. It was not uniformly convex, let it go at that; but at least the works were all inside.

There is nothing more pathetically out of place than a premature sigh of relief. We gave one when our bulb was done, and thought our troubles were over. Over? Odds-fish! as Shakespeare says; we had only sown the seeds of trouble and the crop wasn't up yet.

There was our bulb; the next thing was to put a vacuum inside of it. On looking into the subject of the vacuum, or I should say vacua of different degrees of vacuousness, we learned that the one we required was of the class known as "some" vacuum and not the common, or five-and-ten-cent-store variety, such as occurs in the steam-pipes of a winter's evening when the janitor is absent at his lodge meeting. Patiently dropping back another step, we built a mercurial pump on the lines laid down by one—Sprengel.

Now I doubt if Sprengel invented his pump as a grudge against us "bugs," though if he did he must have died happy, if he has died; for the purchase of the mercury

threw us, financially weakened as we were, into profound bankruptcy, while the operation of the pump deprived us of hundreds of joyous hours which it should have been childhood's privilege to spend in chasing butterflies, or golden-haired high-school girls.

We hitched on our poor, mis-shapen bulb and began pouring that mercury. You put it in at the top, I recall, and it gurgled down through the thing till it came out at the bottom and you caught it and started it over again. Its gurgling was supposed to gurgle the air out, but somehow it didn't. That is, after securing a moderate vacuum, there seemed to be always more air to come.

Of course, Sprengel had his alibi; he said there was a lot of air "occluded" in the pores of the glass. This occlusion was a "new one on us," and it seemed like a mighty roomy place to store air, if you wanted anything of that kind; but we believed implicitly in good old Sprengel, and pumped, and pumped, and pumped.

You've heard of Mrs. Partington and her mop. Mrs. Partington was dissatisfied, for some reason, with the prevalence of the ocean near her home; and, observing that her mop would transfer water from place to place, and that the sand of the beach absorbed it quite readily, she undertook to tuck the ocean inside the beach by this means. People familiar with hydrostatics, doubt the truth of this story, but they fail to make enough allowance for feminine determination. No one accustomed to a "spring cleaning," the way a fussy housekeeper does it, would see anything improbable in the yarn.

Well, our case was much the same as Mrs. Partington's; for, as we discovered afterward, there was an invisible crack in our bulb and, to get a vacuum, we should have had to pump the earth's entire supply of atmosphere through it. I have to admit we gave up the job. It was the first job that completely stumped us. But it served a purpose (you can always find some good blow in an ill wind) for it implanted in us a germ of distrust in our scientific power. Only a germ, mind you, that's all; but it eventually blossomed into the winning modesty that distinguishes us to-day.

I hate stories of failure, and I wouldn't tell this one, except to show how nearly impossible it is to discourage a real "bug." He is like our bulb, in one way: you can exhaust any amount of enthusiasm out of him, by failures and disappointments; but he is connected up with the world's main stock of enthusiasm, and you couldn't draw his "pep" down to three millimetres by the application of "outrageous misfortune" for a lifetime.

Direct public wireless service connecting Japan with other countries, has been inaugurated between Ochiishi, on the east coast of the Kokkaido, and Petropavlovsk, in Kamchatka, Siberia.

THE ELECTRICAL MECHANISM OF THE ETHER.

(*Continued from page 326*)

In the dielectric or insulating medium of a condenser the electrons are considered *tied*, as it were, to the material atoms or molecules of the insulating medium. They are not supposed capable of extended migratory movement from the individual atom. Thus for an alternating E. M. F. large current volumes can be set up but cannot, however, be maintained unidirectionally to any considerable extent. Of course, in conductors this limitation is not present and the electrons are free to travel in a complete physical circuit.

The question can also arise as to how an alternating current can be maintained when there is nothing but the ether between the plates of a condenser. Would such a medium constitute a perfect insulator? The answer for an alternating E. M. F. is, "No." In fact, besides the Lorentz electrons, *with, however, a material nucleus added,* one must, because of this, fall back on a true Maxwellian, purely etherial displacement. According to modern electron theory the true Maxwellian, purely etherial displacement is always present in a dielectric, but superposed upon it in material media is an *electronic displacement, with a material nucleus.* The original Maxwellian displacement was structurally undefined. In insulators the electrons are *tied*, but in material conductors the electrons are *free.* It would be expected that since the electrons have a material *core* that these elemental charges should be associated with material media, but the true ether displacement currents of Maxwell, in which the material core is absent entirely, offers considerable difficulties to our understanding or rather visualization.

In the older theory, such as that of Ampere, the current flowing in a conductor was considered to be altogether distinct from the current flowing in a condenser. It was Maxwell who insisted, however, that a condenser current in the insulating medium itself must set up magnetic effects equivalent absolutely to those set up in a conductor of like current capacity.

Nowadays the conductor current of Maxwell's mysterious days is pictured as being due to an electronic stream of particles having a material nucleus, but the old purely etherial condenser current of Maxwell has still held its ground but superposed upon this current notion is the one in which, for material dielectrics, electrons are in addition considered to be displaced to a limited extent just as in the old Maxwellian ether displacement current.

In considering the manner in which light reaches us from the sun, since this is understood to be an electro-magnetic wave phenomenon, it would appear to be really of the nature of a true Maxwellian (or pure Lorentzian) character. That is to say the light waves in leaving the sun pass out like straight line streamers of a reeled off link chain in all directions. The one set of links lying in a plane, see Fig. 1, represent the displacement circuits of electricity, which Maxwell pictured as due to a flux of pure ether particles in such a circuit.

On the other hand the links looping the first set of links in a plane perpendicular to the latter, represent the closed paths of magnetic disturbances which Maxwell considered was due to what he called "idler" ether particles. Now, in considering electro-magnetic waves set up by an aerial in wireless telegraphy, the original displacement loops are not considered to lie wholly in ether, as they must do, when electric waves in the nature of light are sent out by the sun.

In wireless work such displacement loops are partly true Maxwellian (i.e. they consist of a pure etherial displacement in ether) and partly what one might call Lorentzian, or modified Lorentzian, because a portion of the loop path passes through the earth. That part which passes through the earth would be due to *electrons* according to modern theory, whereas the remaining part in the ether, or air, would only be due to electrons if the air was what is called *ionized;* otherwise the actual electrical displacement in the ether part of the circuit would have to be considered pure Maxwellian.

The difference apparently between a *Maxwellian ether particle* and a *Lorentzian electron* is that Lorentz's electron is supposed to account for the electrical conductivity in solids, liquids and gases or what is called ionization, whereas Maxwell's ether particle is supposed to account for the normal etherial conductivity.

ENGINEERING AS A VOCATION.

(*Continued from page 329*)

business men term it, for an insignificant sum. In some cases, however, the graduate, through personal or parental influence, finds his way into a berth *de luxe* in so far as financial considerations are concerned. The matter of salary is indicated in a general way from a table showing the salaries which may be expected after various numbers of years' service in practical engineering work, as published in a worthy volume entitled *Engineering as a Career* by F. H. Newell and C. E. Drayer. It appears that the average yearly salary amounts to from $1,200 (from one to two years after graduation) up to $5,000 per year, at a period of 12 to 15 years after graduation. Like every other rule, no matter whether it be of averages or quantities, there are exceptions. Among some of the shining lights in the engineering profession to-day may be mentioned that great master of pure physics and mathematics, Charles Proteus Steinmetz, a man who was evicted from Germany, due to socialistic tendencies, arriving in this country practically penniless, and who to-day commands the princely sum, for services rendered, of $100,000 a year. He is the chief consulting electrical engineer to the General Electric Company at Schenectady, N.Y. Mr. C. E. Scribner, chief engineer of the Western Electric Company, draws a yearly salary not a great deal smaller than this, while there are a considerable number of municipal or city engineers, as well as state engineers throughout the country who hold very desirable positions at salaries ranging from $5,000 and $8,000 per annum up to $30,000 and $40,000 per annum. It may be said that it is a case of hard work and study practically all the time, for those who wish to reach the top, and proverbially it seems that there is always room at the top for the right man.

THE TELEPHONE IN MODERN WARFARE.

(*Continued from page 369*)

ceptacle located on the side of the helmet; this jack is protected by a leather covering.

The various instruments used in this set are compact, and make an effective unit. It is extremely light and the inside of the helmet is covered with felt so as to make it comfortable for the wearer.

Although the present conflict is extremely injurious to the world in general, yet it has proven beneficial to the scientific world, in that it has caused scientists of all countries to develop and improve not only existing devices, but many new ones of great value in many ways and which will assuredly prove adaptable to many industrial problems to arise in the years of peace to come.

THE MARVELS OF MODERN PHYSICS.

(*Continued from page 330*)

light direct for illuminating purposes without the necessity of cumbersome conductors. He noticed five distinct forms of secondary discharge from his coil, controlled by a change in frequency or strength. Three were different forms of brush discharge; one a weak, sensitive, threadlike discharge, and one a powerful flaming discharge. Under certain conditions brush streamers issued from all parts of the coil, even through the insulation, while the brush in its hottest form resembled a jet of burning gas, giving off ozone freely. By stretching parallel wires across a room, a sheet of light may be caused to appear between them while an incandescent bulb or a vacuum tube would glow with a pale bluish luminescence if held near one pole of the coil. The effect of such a current upon air or gas is to alternately attract and repel the particles, setting them in exceeding rapid vibration, thus a large amount of heat is generated and luminosity occurs. Something of this condition, it is suggested, may explain some of the phenomena of the *Aurora,* and if such effects could be regulated over a large area of air space, storms and rains could likely be controlled.

There are a great many Tesla effects of wondrous and striking interest and of much scientific importance, with reference to artificial illumination. With a vacuum tube and a single conducting wire shown in Fig. 4, Tesla obtained a high degree of luminosity. If the filament inside of the tube was flexible it would often rotate in a circle as shown by the dotted lines due to its bombardment by air particles. Mr. Tesla himself believed that a new era of illumination would soon be entered upon, following the discovery that luminosity could be produced directly by the high frequency discharge, or indirectly, as in Fig. 5, with an unconnected tube within the influence of the electrostatic field. Less progress has been made in this direction than might have been expected, though the Moore lamp is of such a type. It is a long tube made to fit the room, and taking about .3 ampere at 12,000 volts. The color of the light is affected by the kind of gas present in the tube, and daylight itself may be quite successfully rivalled. A low efficiency and complication of details detract from the popularity of the light, however.

The latest use for light frequency currents is the production of a wave suitable for wireless telephony, and one of the best present methods for producing these currents is by the musical arc discovered by Duddell. He shunted a condenser and inductance around an arc light circuit and found that the condenser rapidly charged and discharged itself through the arc, setting up oscillations of great regularity and persistence. Such a simple arrangement gave a frequency of 10,000 per second. Valdemar Poulsen, by surrounding the arc with hydrogen and placing it in a magnetic field, obtained much higher frequencies—up to 1,000,000 per second, due to the cooling effect of the hydrogen and the tendency of the magnetic field to blow the arc. The waves sent out by such a device are of such high frequency and constancy as to permit transmitting the human voice with all of its delicate inflections.

This alluring field of high frequency currents, is *not* like many attractions, gilt on the outside only, but is solid gold. What it holds for us in the future we do not know, for achievements of the past are only a foretaste.

[*Eighth paper of a series prepared especially for* THE ELECTRICAL EXPERIMENTER *by Mr. Rusk.—Editor.*]

NEW LIGHT WEIGHT RADIO SETS FOR AEROPLANES.

(Continued from page 332)

is used to tune the receiver primary. The secondary of the receiving tuner is of the untuned type which makes for simplicity and ease of operation, and is thought desirable as extreme receiving ranges are not necessary for aeroplane work. Variable coupling is provided.

The detector shown at the lower right-hand corner is of the floating crystal type. Silicon with an antimony point is used, on account of its ruggedness and ability to withstand strong signals. The 10-point switch at the left is provided so that additional inductance may be inserted in the antenna circuit to maintain a sending wave of 450 meters in case a portion of the trailing wire should be lost. The gap is mounted in the lower left-hand corner. When closed complete apparatus measures 8x8x7½ inches.

Fig. 4 shows a ½ k.w. transmitter panel. This set is somewhat more elaborate and heavier than the other. It is equipped with a 3-wave-length shifter, antenna transfer switch, 700-cycle volt- and ammeter, radiation meter, A.C. and D.C. line switches, generator field rheostat and measures 12x18 inches. The range on the set with an average ship's antenna is 200-400 miles. A number of these sets have been furnished for use on private yachts, but they are also adaptable for automobiles and for field use; it is expected that the Government will use this type of apparatus for aeroplane work, as the range under such conditions is far greater than that of any other set of equal weight now being built.

A MOTORCYCLE RADIOPHONE OUTFIT.

(Continued from page 333)

flexible conductors as indicated in the photograph.

Another very interesting thing about this portable outfit is the container in which the instruments are kept. This is built entirely of metal and so designed that the various side walls can be removed at will. Our first illustration shows the top opened so that the one in charge of the set can inspect the generating unit, including the engine, with ease. Another cover below this one protects the generating instruments. This is also shown in Fig. 1.

A special stand is provided to support the apparatus. When the instruments are to be used, it is removed from the chassis and the case is placed on it. The legs of the table are designed so that by merely forcing the complete unit into the compartment, they collapse and fold together thus permitting the complete outfit to slide into place with ease.

Undoubtedly outfits of this type will be very advantageous for Uncle Sam's signal corps in event of international conflict.

NEW YORK POLICE PASS WIRELESS TESTS.

Chief Inspector Max Schmittberger was informed by officials of the Brooklyn navy yard on July fourteenth, that three police lieutenants and five patrolmen had passed examinations at the training school for radio instruction at the navy yard and had been awarded certificates conferring on them the title of commercial radio operators of the first class.

The men were Lieutenants John A. Altenbach of the Atlantic Avenue station, Brooklyn; George H. Quackenbos of Headquarters; William H. Van Keuren of the East Twenty-second Street station and Patrolmen George Wolf, Emil Kopke, George T. Valentine, Michael C. Morney and John F. Murphy.

EXPERIMENTAL CHEMISTRY.

(*Continued from page 343*)

crystal, we have caused gases to be given off, which condensed on the sides of the tube, and on the rod, forming finer divided crystals of the same substance with which we started, namely iodine. The process of Sublimation closely resembles Distillation, the distinction between the two being, that in Distillation, water was converted into a vapor, and then condensed to a liquid. In Sublimation the substance does not pass through an intermediate liquid state, but the solid vaporized, and the vapor condensed directly into the solid state. The product of sublimation is called a *Sublimate.*

CAUTION: *Do not allow any of the iodine crystals to come in contact with the skin.* To remove the iodine from the test tube, pour in a little alcohol, and shake thoroughly, being careful not to allow any to get on the skin, as it leaves a stain.

EXPERIMENT NO. 13—

DECOMPOSITION.

Put about 5 or 6 crystals of Lead Nitrate $[Pb(NO_3)_2]$ into a perfectly dry test tube. By means of a test tube holder (Fig. 18) hold in the flame of a Bunsen burner for a minute or two.

[WARNING: Keep the tube pointed away from you, and do not hold your face over the mouth of the tube, as the crystals have a tendency to jump out of the test tube upon the application of heat. There is no danger attached, only be careful not to have your face over the mouth of the tube.]

After the heat has been applied to the lower part of the tube containing the crystals a short time, a crackling noise will be produced, and some of the solid will tend to jump out of the test tube.

Notice and record the color of the fumes which rise in the tube, as well as the color of the liquid which has formed in the bottom of the tube, caused from heating the crystals. Record any additional phenomena which you notice in the tube.

Decomposition is just the reverse of Synthesis, (Exp. No. 9) in that, in Synthesis we build up a compound from its elements, and in Decomposition we decompose or break it up into its elements, thus:

$$\underset{\substack{\text{Lead}\\ \text{Nitrate}\\ \text{(Compound)}}}{Pb[NO_3]_2} = \underset{\substack{\text{Nitrogen}\\ \text{Peroxide}}}{2\ NO_2} + \underset{\substack{\text{Lead}\\ \text{Oxide}}}{PbO} + \underset{\text{Oxygen}}{O}$$

(elements)

The elements Iron and Sulphur, were employed in synthesis (Exp. 9) to build up the compound Ferrous Sulphide, thus:

$$\underset{\text{Iron}}{Fe} + \underset{\text{Sulphur}}{S} = \underset{\substack{\text{Ferrous Sulphide}\\ \text{(compound)}}}{FeS}$$

(elements)

The above reactions, as shown by the equations, should give the reader the methods of building up a compound, and breaking it up.

[WARNING: *Work this experiment near a window where a draught can be created, as the brown fumes contain Nitrogen peroxide, a poisonous gas. If worked in a draught there need be no fear. Of course, it is advisable to keep the tube as far away from you as possible.*]

EXPERIMENT NO. 14—

METATHESIS

or

Double Decomposition.

Dissolve about 1 gram of Lead Nitrate $Pb.[NO_3]_2$ in about 10 c.c. of water in a test tube. Dissolve about 1 gram of Sodium Chloride [NaC1] [common table salt] in 10 c.c. of water in another tube. The crystals when heated will dissolve much more readily. If the solutions are heated, allow some cold water to run on the lower part of the tube, after the substances have dissolved, in order that the solutions will cool rapidly. When both solutions are cool, pour one into the other and notice and record your observations.

Upon mixing these two solutions you will notice that a white substance has formed in the bottom of the test tube. This substance is called a *precipitate* which is caused by the Lead Nitrate and Sodium Chloride exchanging places. We started with two liquids, which manifested no appearance of containing any white solid in them, and by mixing the two, caused a white solid to form. This process of causing a solid to form by mixing two or more liquids is called Metathesis or Double Decomposition, and is used a great deal in chemical analysis, to determine the presence of various substances.

The visible product or *precipitate* which has formed is Lead Chloride, and the Sodium Nitrate has remained in solution, according to this reaction, the equation is:

$$\underset{\substack{\text{Lead}\\ \text{Nitrate}}}{Pb[NO_3]_2} + \underset{\substack{\text{Sodium}\\ \text{Chloride}}}{2NaCl} = \underset{\substack{\text{Lead}\\ \text{Chloride}}}{PbCl_2} + \underset{\substack{\text{Sodium}\\ \text{Nitrate}}}{2NaNO_3}$$

In Fig. 19 there is shown a cheaply made table rack for the Experimental Chemist. It will be found extremely serviceable as it is poor practice to have all kinds of acids and salts lying about indiscriminately.

HUDSON RIVER BOATS TO HAVE WIRELESS.

For the first time in the history of navigation, wireless is to be installed on Hudson River steamers. The Hudson Navigation Company has announced that the *C. W. Morse* and the *Berkshire,* the two largest vessels in the Hudson River passenger trade, have been equipped with Marconi apparatus and that the rest of the company's fleet would be similarly fitted if the new feature proves successful.

Land stations have already been installed at New York City, Poughkeepsie and Albany. Women operators, dressed in natty blue uniforms, will do the receiving and sending on the steamers.

The company was urged to install wireless on its steamers by business men who could not afford to be out of touch with shore for ten or twelve hours at a stretch.

In order to meet atmospheric conditions it was found necessary to lengthen the masts of both vessels and some experts declare that even now it will be difficult to operate the system when the steamers are in certain parts of the river where there are mountainous elevations on both sides.

The Hudson Navigation Company has arranged to serve its patrons with a general wireless news service which will include reports of New York and Brooklyn baseball games by innings.

NEXT "MAN BEHIND GUN" IS ELECTRICAL ENGINEER.

W. T. Snyder, newly elected president of the Association of Iron and Steel Electrical Engineers, says:

"When we have decided to make use of the vast amount of water power which is going to waste; when the waterfalls in the Rocky Mountains will help to roll steel in the Eastern States at the same time it is helping to grind wheat in Minnesota; when there will be universal application of electric energy even to domestic purposes; when the day that Dr. Steinmetz predicted will come and our country will be covered with a vast net-work of transmission lines—then the electrical engineer will be 'the man behind the gun,' for steam and many other forms of applied energy will soon be replaced by electricity."

E-VERYONE C-AN R-EMEMBER OHM'S LAW.

To remember Ohm's law easily says a writer in *Telegraph and Telephone Age*, arrange the three letters *C E R* (which indicate the electrical quantities), in the form of a triangle, as shown, remembering that *R* goes in at the "right" hand corner of the triangle. The positions of *E* and *C* can be readily recalled when we know that *E*-veryone *C*-an *R*-emember.

E
C R

In order to ascertain the value of any one of the quantities simply place a finger over the unknown quantity and the operation upon the other two quantities is indicated by their relative positions. Thus, for instance, to find the value of *E* cover that letter, which leaves *C* and *R* on a level, indicating multiplication. To find the value of *R*, cover *R*, thus leaving *E* over *C*, indicating division. *C* covered leaves *E* over *R*, also indicating division.

It is important, however, to use the formation of triangle in order to give the scheme a formula effect and impress upon the student a mental conception of the operation.

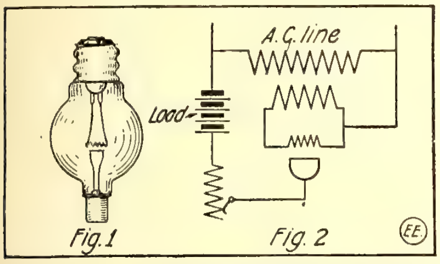
ELECTROLYSIS DAMAGE AT TRENTON, N.J.

The Water Department of Trenton, N.J., has recently tendered a statement to the City Commission showing that it is costing the municipality on an average of $2,000 annually to replace the water service lines on North Clifton Avenue. It is held that electrolysis caused by the system of the Trenton & Mercer County Traction Company on this thoroughfare is responsible for the damage, and that in some instances the large water mains also show signs of deterioration through this cause. Expert examination a few months ago showed that the electric energy escaping from the trolley lines was responsible.

NEW ARGON FILLED GAS RECTIFIER.

From the first experimental work with electrical conduction through gases, a number of practical instruments have been developed. One of these is the Kenotron tube, manufactured by the General Electric Company. This tube, Fig. 1, is used as a half wave rectifier on high voltage circuits. It can handle currents of 250 milliamperes at a potential as high as 100,000 volts. Because of the large voltage drop, 100 to 500, it cannot be utilized on low potential circuits.

The glass bulb of this tube is three inches in diameter. The upper end is fitted to



Connection of New Vacuum Tube Rectifier Containing Argon Gas.

screw into a socket, while the other end is formed as a contact for one side of the rectified current. A spiral filament, welded to heavy tungsten wires, gives off the negative ionic discharge. The anode, or large tungsten plate, is swaged directly from the lead which passes through the glass. Argon gas, at a pressure of 3 to 8 centimeters, cold, is used within the bulb.

Fig. 2 shows the connections of the Kenotron tube with a 40 watt transformer for filament excitation, a load, and regulating resistance. This method, however, is not as efficient as the full wave rectifier employing two bulbs. A special bulb has been constructed for this work, although two half-wave tubes can be used.

PRESSED STEEL ELECTRIC VACUUM CLEANER.

The idea of substituting pressed steel for aluminum in vacuum cleaners does not seem at first advisable, but this construction brings out a number of advantages over the usual construction. Because pressed steel is used, the case is made quite thin. Nickel plating is used as a finish, which is impossible on aluminum. The inside is perfectly smooth, so that no lint or dirt can catch there. A new ventilation system is used, which draws air from the top of the electric motor housing, through the armature, and out the lower edge of the case. Another point of construction is the central oil reservoir, from which all the bearings are lubricated.

MAGNETIC SURVEY ERRORS

Errors in existing magnetic charts to the extent of twelve to sixteen degrees have been found as a result of the work of the magnetic survey yacht *Carnegie*. This craft has circumnavigated the globe between parallels 50 and 60 degrees south.

ARE YOU LOOKING FOR NEW WORLDS TO CONQUER?

If you are falling short of interesting and worthy topics on which to write about or perform research work on, here is a list of a few mentioned as research subjects in the Proceedings of the American Institute of Electrical Engineers for May, 1916.

Radio Transmission.

Methods for producing damped oscillations for transmission purposes.

Methods for producing damped oscillations of particularly constant amplitude for laboratory measurement purposes.

Methods for producing undamped or continuous oscillations for transmission purposes.

Study of radio detectors

Study of radio amplifiers.

Study of the "beats" receiver and methods for producing oscillations for the same.

Comparison of "tikker" and "beats" receiver for the reception of undamped waves.

Advantages and disadvantages of using the "beats" receiver for damped waves.

Directive radio communication. Study of the variation of signal intensity with varying wave lengths. Methods of modulating the antenna current for radio-telephony.

Design of a compact portable decremeter.

Study of radio measuring instruments.

Design and construction of portable radio sets.

Design and construction of radio apparatus suitable for instruction and demonstration.

Modern theories of propagation of electromagentic waves (without mathematics).

Experimental determination of "radiation resistance."

Mathematical theory of radio transmission.

Miscellaneous Problems.

Agriculture, electricity in.

Amplifiers for weak currents and voltages.

Arc phenomena.

Automobile starting, lighting, ignition.

Atmospheric electricity, oscillograph study by means of an antenna.

Circuit breakers.

Electromagnets.

Farm lighting and power.

Fixation of atmospheric nitrogen.

Fuses.

Heating and cooking; heat accumulators; high-resistivity alloys; temperature control insulation.

Magnetic separation of iron ores.

Marine applications of electricity; electric drive of an ocen steamer.

Pictures, transmission of, by electricity.

Precipitation of suspended matter; smoke abatement.

Rectifiers, aluminum, cathode ray, mercury, revolving, vibrating contact.

Safety rules, standardization rules, and standard specifications of various associations in this country and abroad; a critical comparison

Submarine signaling.

Thermo-electricity, generation directly from fuel.

Telegraphy, rapid, multiplex, submarine with alternating currents.

Telephone apparatus for the deaf.

Telephone transmitters of great power; sensitive telephone receivers and relays; phantom circuits.

Water purification by electricity.

Welding, electric.

Our readers will no doubt realize that many rather ordinary topics appear in this list, but there is always room for more detailed investigation along these lines. Who will be the first investigator to chart the radiated wave forms occurring about a radio antenna?

How It Feels to Be in a War Submarine

THE engineer throws the lever and the submarine begins to submerge. We have all felt the helpless sensation when an elevator starts on a descent, and in the submarine, if we are to credit an account taken from the war diary of a German submarine commander and published in the New York *Evening Post,* it is exactly duplicated. What life is like when one is in the depths of the sea, or tangled in a net which the British have spread, or when mines and bombs are exploding all around, is told in part by this commander, who has kept a diary of events. This is how it reads:

Three minutes past six. Sunrise due in half an hour. Sea and sky a solid dead-gray. Horizon not visible and only to be guessed at. Our periscopes ceaselessly sweep the leaden obscurity. Sudden shock, as of electricity, tingles through me. Into the periscope's field of vision moves a black shadow. At first only a shadow, it grows, assumes a shape, a long, black hull; one, two, three, four funnels grow, like tree-trunks, out of the fog. A destroyer!

Submerge! The alarm sounds. Flood tanks! One leap into the conning-tower! The hatches come banging down over my head. The water roars into the tanks. Now for the torture of suspense, while, watch in hand, ticking off the precious seconds, I wait till the tanks fill and the old perfecto takes her time plunging. Longest seconds of my life! The destroyer, which wasn't more than 2,000 yards off to begin with, comes pounding down on us, putting all her 40,000 horse-power heart into the business. Her bow guns are as busy as sheet lightning of a hot summer's night.

"Donnerwetter! If he only doesn't get us this time." One bull's-eye, and it's all up with the undersigned. Thank God, I hear the water tickling the little panes of glass in the lookout of the conning-tower. But I can see the monster's shadow swiftly moving across the ocean's surface. Like a hammer-stroke on an anvil, his shells burst around us. Devil take the fellow, he's getting our range! Another try, and he wins the cigar. But just then daylight fades away, and darkness closes down on the lookout windows like a solid shutter. The oldtub obeys her rudder and wiggles down under the water.

The mellow light of electricity now wraps us comfortably about like a new woolen blanket. The manometer's indicator registers the following depths: eight yards, nine yards, then ten, and finally fourteen. Saved! Really there's no sensation like this of being buried securely in the depths of the sea. Our trusty perfecto keeps right on on the downward path, beautifully sensitive to bow- and stern-rudder, which are the bridle and spur of a reliable submarine. Twenty-four yards, twenty-six, announces our honest manometer. I've told them to keep right on going down till they register thirty yards.

Way up yonder, somewhere on the ocean's roof, we can still hear the Frenchman angrily gesticulating and spitting fire. Much good may it do him!

We were heading downward. The manometer registered seventeen yards. Suddenly something hit us, knocked us on the head, and sent us down and out. We might as well have been hit over the skull with a belaving-pin. When we came to, we were lying scattered about in various picturesque attitudes, holding our bruised heads and shoulders. The boat was trembling and shaking like a nervous horse. The lights had gone out and left us groping.

"The safety-switch!"

"No use. She has gone dead as a doornail."

"Try the reserve battery!"

And then suddenly daylight switched on once more.

What was up? Why weren't we done for? Why didn't the ocean come cascading in on us and nail us to the bottom? There is no question but that we had hit a mine and sent it off with a terrific bang. From all quarters now came shouts of "Bow all tight and shipshape; starboard and port tight as a drum; stern free and clear!" But at this moment the ship began to lurch downward; bow down, stern up. She was practically standing on her head.

"Something wrong with the steering-gear, Cap," shouted Lieutenant Gröning, who was at the wheel. "She doesn't mind her rudder as she ought. We've got caught on a rope or in a net."

"Himmelkreutzdonnerwetter! We were just wanting that on top of everything else. Here we are neatly netted, with a string of mines, no doubt, just overhead. There's nothing to it."

"Look sharp," I shouted. "Keep her headed down, full speed on! Don't let her come to the top. There are mines up there."

The engines started humming, the ship butted forward into the net, boring, ripping, and tearing as she went, and finally rent the steel trap to shreds like so much mosquito-netting.

"Three cheers," shrieked Gröning, out of the ship's bowels, "we're through. She steers as easy as a bicycle."

"Down you go," I ordered. "Try for fifty meters." What had happened was this: When we hit the net the shock must have set off some fuses which in turn exploded the mines woven into the upper portion of the net. These mines were so placed that they would have caught a submarine cruising along near the surface in the usual way. Had we tried to attack the destroyer, or for any other reason kept within striking distance of the upper world, we surely would have landed in the net exactly as our friends the enemy planned, so as to hit and explode the mines directly. As luck would have it, we dived, and the mines exploding far above us did no further damage than to scare us stiff and decorate the old hulk with a few new beauty-spots.

Surely the Frenchmen up yonder must have embraced and kissed, as is their custom, all around when they heard and saw that terrific explosion; no doubt they wirelessed the glad tidings at once, "Enemy submarine caught in net and destroyed by mines." Well, we didn't grudge them any of their chuckle, if only they would let us alone for a bit. I admit we had had enough for the time being.

But even more exciting was an encounter with a trawler, one of the fringe of the British fleet sent out expressly to dispose of some of the troublesome submarines. The U-boat had been sighted and the trawler sped forward on a death-dealing errand. She was as relentless as Death itself, and, it seemed, as inevitable. The submarine captain writes:

"The fellow's crazy," I shouted. "He wants to run us down. Full speed ahead! Hard 'o port!"

But it almost looked as if we'd got started too late. The trawler had accumulated momentum enough to better us considerably in the matter of speed. She came at us, panting and growling like an asthmatic old bulldog. The original interval of two hundred yards that separated us was getting uncomfortably less and less. Her foam-showered bow towered above us scarcely fifty yards away.

In true proverbial fashion, the hair on

our heads was beginning to get restless under our headgear.

"Pistols and rifles this way," I shouted, from the conning-tower. No sooner said than done. We now opened fire on the rapidly approaching monster. I could already see the watery-blue eyes of her enemy captain light up with fiendish glee in the seamy waste of his weather-worn face. Closer and closer they came, nearer and nearer moved the steel cliff of ship's bow. I felt like part of my ship, and the anticipation of the blow was like a knife-edge in my back.

Twenty yards, fifteen! Wasn't there any way out? Surely! Gröning, the trusty, came to our rescue. He was kneeling on one knee, sending shot after shot into the trawler. Suddenly he switched on a bright idea, like an electric sign of a cinema at nightfall in Unter den Linden:

"Everybody aim for the man at the wheel."

In the little mahogany steering-tower, with windows all around him, like a manikin in a show-case, stood the helmsman of the *Ormea*, carefully selecting a soft spot in my turtle-back to land on with his bow-point. We could see him as plainly as if he were on the inside and we on the outside of a store-window.

Gröning's bright idea got us all busy on the instant. We quit aiming at the oncoming bow, which didn't object to our attentions at all, and concentrated on this one man. Our volley of shots rattled out noisily. From across the way came an almost simultaneous cry. The Englishman threw his hands up, fell forward across the wheel, which whirled about at the instant of release.

Slowly the juggernaut bow veered to one side, but ripped by so close that in passing she side-swiped us, and left us with the souvenir of a dented water-tank.

Directions for Designing, Making and Operating High Pressure Transformers. By Prof. F. E. Austin, B.S., E.E. 46 pages; 21 illustrations; 7¾x4¾. Cloth covers. Price, 65 cents. Published by the Author, Hanover, N.H.

This little volume is a brief but valuable treatise for those interested in the construction of high-tension transformers.

The author tells in plain language how to calculate and obtain the various dimensions for different sizes of closed core high voltage transformers for use on any ordinary low-tension circuits. The copper and iron losses and their usual values are explained; also the method of calculating them. A table of the loss in watts at 15, 25, 60 and 100 cycles frequency for a cubic inch of transformer iron is given. An example is given for the calculation of a 20,000-volt, 1 kilowatt, closed core transformer, for use on a 110-volt, 60-cycle circuit. Suggestions are offered on the manner of assembling the iron core laminations, and the sectional secondary method of construction is illustrated in detail. The possibilities of a transformer being used as a frequency changer are mentioned, as well as the method of connecting primary coils to produce different secondary potentials.

Romance of Reality—Electricity. By W. H. McCormick. Cloth bound, 8¼x6 inches; illustrated by photographs and drawings; 293 pages; price, $1.50. Published by Frederick A. Stokes Co., New York.

Those who have only a superficial knowledge of electricity will find this book of interest, as it explains, in a popular way, the different applications of electricity. The apparatus described is of British construction, for the most part, but the devices differ little from those in use in America. Almost every subject is discussed, from atmospheric electricity and magnetism to industrial electrolysis and electro-culture. There are two particularly good chapters on the English telephone systems, and an interesting account of the use of wireless in the European war.

MARCONI COMPANY PROFITS.

The Marconi Wireless Telegraph Company of America announced recently that the ordinary general meeting of the Marconi Wireless Telegraph Company of England was held in London June thirtieth, and that the profit of the latter company for the fiscal year, closing December 31, 1915, amounted to £377,000. (One pound equivalent roughly to $5.00 American money.)

The directors recommended a final dividend on the ordinary shares of five per cent. The amount carried forward to profit and loss, according to the cablegram, is £307,000.

A TRACKLESS-TROLLEY BATTERY CAR.

In Bradford, England, the general manager of the municipal city tramways has shown not a little ingenuity in converting an old electric trackless-trolley car into an electric truck. At the present time the vehicle makes use of the overhead-trolley current supply while traveling along the tramway route, and by means of a storage battery which it carries it is enabled to leave the route and travel a distance of several miles on the stored-up current. But one trolley wire is used, the return circuit being effected by a grounding device in the form of an extension of the steering arm, terminating in a contact shoe bearing on the track. The trolley-supply voltage is 500, and that of the battery but 150. However, the latter is found sufficient to drive the car at a slow speed while journeying away from the tramway route.

Refer also to an article on "Transcontinental Electric Autos" in the July, 1916, ELECTRICAL EXPERIMENTER.

OBITUARY.

J. Frank Morrison, aged seventy-six years, one of the foremost electrical men in the early days of the electric light, and an old-time telegrapher, died at Baltimore, Md., July third. He was for many years manager of the Western Union office at Baltimore, and was one of the most prominent politicians in Maryland. He reorganized the police and fire alarm systems in Baltimore and placed them on a sound footing. He was president of the famous Crescent Club of that city, the political stronghold of Maryland. He was also president of the Southern Electric Company and the Brush Electric Company and the National Electric Light Association. During his career he made and lost many fortunes.

WITH THE AD MAN.

I have been wondering since we got out our July issue with its important announcement of the increase in price of THE ELECTRICAL EXPERIMENTER from ten to fifteen cents, if you appreciate how much the advertiser is doing to help the publishers out in these strenuous times, when costs are rising over night. Our advertisers have gallantly come to the aid of your magazine by taking larger space, in the hopes that the additional revenue will tide over your monthly visitor until times are again normal, for after all, my friends, while your price has been increased five cents per month, it is the advertiser who pays the "freight." It is to him that we must look for the real revenue that pays our enormous paper and printing bills. He is spending his good money to introduce to you his products, services or books, as the case may be. He is entitled to your support. He not only wants you to read his ads and be interested, but he wants you to send for his literature and when you are in need of what he advertises, he expects, and very rightfully expects, that you will patronize him. Every advertiser in THE ELECTRICAL EXPERIMENTER is an actual supporter of the magazine. If it were not for the advertisements, the magazine could not be published. I know that in the past you have patronized our advertisers. Now I want you to do more. When you hear of anyone who needs anything advertised in THE ELECTRICAL EXPERIMENTER I want you to take your copy of the magazine over to him and be a real booster for the advertisers in your magazine. It is not hard—costs you nothing and will make for a bigger and better ELECTRICAL EXPERIMENTER.

Can I count on your support?

MILTON HYMES.

Electrical apparatus by which all the movements of a ship can be controlled from the bridge without signaling to the engine room has been invented by a Japanese.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The *Very* people, the *Only* people, who could possibly have a use for your things read this journal. More than 70,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers' advertising accepted in Opportunity Exchange Columns only.

The rates are: *Two cents per word* (name and address to be counted) minimum space 3 lines. Count about 7 words to the line. *Remittance must accompany all orders.* No advertisement for less than 30c. accepted.

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the October issue should reach us not later than August 28th.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

Subscribers experiencing trouble in dealing with any advertiser should notify the publisher very promptly.

OVER 70,000 PEOPLE READ THIS JOURNAL

EXCHANGE—Large motion picture machine and equipment for cabinet audion receiving set. Box 3, Highwood Station, New Haven, Conn.

FOR SALE—12 volt, 3 ampere generator, $3.00; loading coil, $1.00; lightning switch, $1.00; ¾ inch spark coil, $1.50; bicycle equipped, $12.00. Thomas Hicks, 425 West Miner St., West Chester, Pa.

LOOK HERE—Ferron detector, $3.00; Galena detector, 25c.; 1,500 coupler, $2.50; 2 fixed condensers, 50c. each; No. 364 Murdock condenser, $2.00; No. 365 Murdock condenser, $3.50; Studebaker self starter, $20.00; Murdock loading coil, $2.00; Blitzen receiving set, $18.00; Audion bulb with "B" battery, $7.00; rheostat, 40c.; Brandes phones, $4.00; wanted—two commercial keys and a storage battery. Herman Staab, Ironton, Ohio.

WILL TRADE $60.00 audion receiving and ¼ K.W. sending set for Smith motor wheel. Francis Pray, 102 Heath St., Somerville, Mass.

FOR SALE—One cylinder automobile gasoline upright, water cooled, seven horse power, complete with coil, carburator, crank $12.50. Clarence Vaughan, Middletown, N. Y.

MANHATTAN LOOSE COUPLER—Murdock detector, Murdock loading coil, condenser, 500 ohm receiver headband cord, telephone magneto, telegraph set, ½" coil, good condition. $8.00. Rothman, 106 Ross St., Brooklyn, N.Y.

WANTED—Omnigraph No. 2, Junior, will pay cash. State lowest price. R. P. Krajick, 1921 Lorain Ave., Cleveland, Ohio.

FOR SALE—Two Audions, headsets, spark coils, books, variables and experimental apparatus. Send for price list. Correspondence solicited. Louis Hasbrouck, Amherst, Mass.

FOR SALE—⅛ H.P. motor, $6 receiver and headband, 50c., 1 inch spark coil $3.00. Carl Henkelmann, 634 A. St., Lincoln, Nebr.

FOR SALE OR EXCHANGE—One small receiving set $2; one medium receiving set $5; aerial, five wire, fifty feet long, sixteen insulators, $2; two small telephones, work up to ten miles, cost $12 sell for $5; pair of spiked $4 baseball shoes, new, sell for $2; pair boxing gloves, new, cost $4.50, will sell for $2.25. Paair hickory skis, 7 ft., cost $4.50, sell for $2.25; hickory bow, 5 ft., $1; small concert outfit $2; copies of Scientific American, Technical World, Popular Mechanics, Physical Culture, Saturday Evening Post, Adventure, American Photoplay, Motor Age, Adventure, American Boy, Youths Companion, one copy of Harper's Outdoor Book for Boys, $1. I want pastel crayons, Savage repeater, or automatic twenty-two; good books, by such authors as O. Henry, Kipling, etc; copies of adventure or Argosy; Auto harp or Ukalele, kodak, revolver, tennis racquet or fish rod. Write me. L. H. Sargent, Abrams, Wis.

FOR SALE

100 watt transformers, closed core wax impregnated and boxed. Built for firm that has gone bankrupt. Primary 110 A. C. and give ⅜" flame. Price, $2.35 each. Satisfaction guaranteed, wt. 15 lbs. Also limited quantity genuine polished Italian marble panels 14 inches long x 8 inches wide x ⅜ inch thick, beveled, easily drilled; guaranteed brand new, weight 5 lbs. Price 95 cents each. L. R. Jewett, 200 Lewis St., Lynn, Mass.

WE ARE Middle West agents for the Electron Relay. Avoid delay. Order from us. Blue prints of new easily made coupler, 25 cents. Ironton Radio Sales Co., (not inc.) 510 S. 7th St., Ironton, Ohio.

$50.00 AUDION type detector and Premo film pack camera complete with outfit; Edison phonograph and set of Encyclopedia Britannica for sale or exchange. S. Winat, 8-10 E. 107th St., New York City.

COMPLETE WIRELESS sending and receiving set, cost $29.00, will sell for $20.00. George M. Seeger, 401 N. Charles St., Bucyrus, Ohio.

WANTED—Complete wireless outfit, preferably sending and receiving, but would take receiving only. Must be good and cheap for cash. Joseph Haskell, 60 Congress St., Boston, Mass.

1 H.P. ELGIN gasoline engine in good shape, $19.00; 6 volt Knapp dynamo, $2.50; 6 volt $8.00 K & D dynamo, $5.00; 1 pair E. I. Co. No. 6666 phones, $6.00; 1 loading coil, $2.00; tuning coil, $1.50; detector, $1.00; three buzzers, 20c. each; glass, $3.00; Expo watch camera, $2.00; dynamo for $40.00 blasting machine, $8.00; ¼ spark coil without vibrator, $1.00; Crystaloi O new, $2.75; Ajax motor, 75c.; strap key, 25c. All above articles in good working shape. M. Eakle, New Hope, Va.

WANTED—To buy or exchange wireless, electrical and athletic goods. Give particulars. Wayne Wagner, 18 East St., Ashtabula, Ohio.

DO THESE "ADS" PAY?

Mattoon, Ill., June 26, 1916

Dear Sirs:

Talk about results!! I never expected *my little apparently insignificant ad* would bring results, but believe me I have received so many letters and such good results I am convinced that advertising in "E. E." brings results superior to all others.

Yours Cordielectrically
PAUL J. McGEE,
Secretary, Mid-West Radio Relay League.

FOR SALE—A $25.00 course in writing the photoplay. Rare bargain, $18.00. Ray Berg, 613 Union St., Champaign, Ill.

FOR SALE—½ H.P. vertical air cooled 2 cycle stationary gasoline engine, $6 cash, without accessories. Fisher Ames, Massena Springs, N.Y.

FOR SALE—One Stevens 22 repeater used 6 months, $6; and one Stevens 22 single shot in fair condition, $2. Benj. McCaul, Ayr, No. Dak.

WANTED—2 variable condensers, 43 plates with or without case, lightning switch, fixed condenser. Pay cash or exchange for Edison phonograph. Vandell, 328 6th St., Brooklyn, N.Y.

FOR SALE—$14.00 electric locomotive and track, $10.00 or trade for Brandes Navy phones in A1 condition. Locomotive is running finely. $5.00 movie machine, been used once, $3.00, or trade for instant radiograph. $1.00 Daisy air rifle with broken sight, 50c. George Dimon, 367 Genesee St., Utica, N.Y.

SALE OR EXCHANGE—1 set, 3 vols., covering I.C.S. draftsman's course, make offer. A. I. Darnall, Searcy, Ark.

FOR SALE—1,000 meter coupler, $3.00; electrolytic detector, 75c.; condenser, 35c.; ½ K.W. transformer, $8.00; 2 magneto desk telephones, $6.50 each; watchcase receivers, 30c.; 3,000 meter loader, $1.50; telephone transmitters, 70c.; Thordarson toy transformers, $4.00, type S motor, $3.00, 2 volt, 40 ampere storage, $1.50. What have you? Hester Little, South St., Lockport, N.Y.

FOR SALE OR EXCHANGE—5x8 brand new printing press and complete outfit, including 4 fonts of type. Bargain. R. C. Arnaud, Keene, N.H.

FOR SALE—Interstate receiving outfit used three months, $3.00; 1,000 ohms receiver with headband, $1.90; collection of 575 precancelled stamps, $4.50. Harold Booth, Belcherttown, Mass.

BLITZEN radiocoupler, $5.00; 2,000 ohm headset, $4.50; brass key, $1.50; DeForest audion bulb, $2.00; loose coupler, $4.75; pancake oscillation transformer, $4.00; phonograph with records, $4.50; Robert C. Bishop, 413 Locust St., Lockport, N.Y.

EXCHANGE—Lot of goods; want typewriter, gasoline engine or storage battery. Write for list. Frederick Towns, Marlboro St., Keene, N.H.

FOR SALE—Large 20,000 meter coupler, $12.00. Send for list of other wireless bargains. Charles Roberts, 2051 N. Lawrence St., Philadelphia, Pa.

WANTED—Navy loose coupler. Have other articles to trade for wireless instruments. Brewton Berry, Orangeburg, S.C.

WILL EXCHANGE $25 Ransomerian penmanship course for first-class high range wireless receiving apparatus. Joseph J. Schiller, Oenaville, Texas.

SACRIFICE—First $6.00 gets 1-inch coil, 1 spark gap, 1 electrolytic interrupter, 2 one quart Leyden jars, 1 extra heavy ½ K.W. gap, R. W. Hoffman, 4011 Greer Ave., St. Louis, Mo.

FOR SALE OR EXCHANGE—$18.00 White Cross vibrator for 110 A.C. and D.C. current, like new. Want Victrola. Also $10.00 electric mirroscope for best offer of cash, camera, electrical goods or what? K. Bard, Manawa, Wis.

FOR SALE—Wireless apparatus, key and sounder, Kodak tank. Want Omnigraph or what have you? Will sell for cash. Thos. Shay, 768A Quincy St., Brooklyn, N.Y.

FOR SALE—Two 8-inch spark coils; two ¼-inch coils, telephones, lathe, emery wheels, tools and tool chest, helix and tuning coils. F. E. Austin, Hanover, N.H.

QRX: CAN U USE—Radio Apparatus Company's rotary gap, $9.65; Blitzen ¼ K.W., $9.40; Murdock oscillation, $3.00; Holtzer-Cabot phones, $5.95; 30 ampere key $1.00; Navy coupler parts, fibre, $2.45; lightning switch, $1.50; ¼ K.W. gap, 35c.; step-down transformer, $3.00. Write immediately. All letters answered. C. R. Barnickol, 2317 Milwaukee Ave., Chicago, Ill.

FOR SALE—6 H.P. water cooled gasoline engine, suitable for cycle-car, $25.00; 9-inch lathe castings (nearly finished), $30.00; small photo for red stamp; two bridging phones (one minus magneto), $8.00. Liberal discount if sold at once. Blue prints for lathe extra. Morse Lloyd, 1405 Ninth St., Portsmouth, Ohio.

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the October issue should reach us not later than August 28th.

OVER 70,000 PEOPLE READ THIS JOURNAL

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N.Y.

MURDOCK "FIFTY-FIVE"

2000 OHM
DOUBLE SET
COMPLETE
$4.00

3000 OHM
DOUBLE SET
COMPLETE
$5.00

IT IS A FACT—

that at these remarkably low prices, YOU may obtain a head-set which, in beauty of appearance, quality of materials, and supreme sensitiveness of operation, will surely equal and possibly surpass *any* 'phones you may buy at *double* the prices.

Our FOURTEEN DAYS' trial offer and positive "money-back" guarantee assures satisfaction. Order NOW.

OUR CATALOG IS FREE

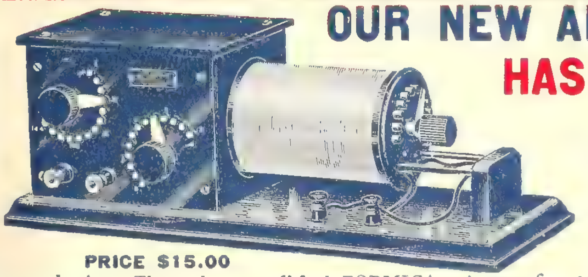
221 Second Street,
San Francisco

WM. J. MURDOCK CO.

55 Carter Street,
Chelsea, Mass.

WE ARE HEADQUARTERS FOR ELECTRICAL AND WIRELESS GOODS

OUR NEW AMCO NAVY TYPE LOOSE COUPLER HAS MADE A TREMENDOUS HIT



PRICE $15.00

THE NEW AMCO NAVY TYPE LOOSE COUPLER embodies the most recent advances in the design of receiving transformers. High frequency resistance loss, capacity loss and leakage have been cut down by the use of special materials and methods. The primary winding is enclosed in a cabinet, the sides and top of which are polished black FORMICA, giving a finish and having insulating qualities far superior to hard rubber. FORMICA is also unbreakable.

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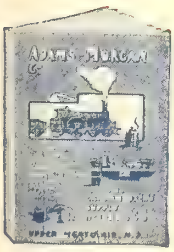

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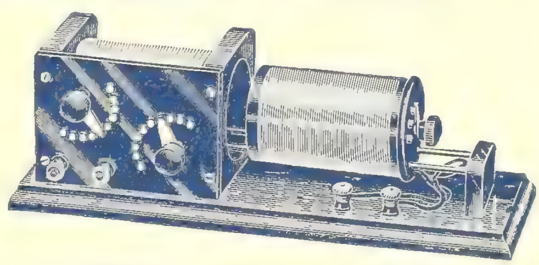

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The Electrical Experimenter

233 Fulton Street, New York.

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Vol. IV Whole No. 42 **CONTENTS FOR OCTOBER, 1916** **No. 6**

Gravitation

WHEN we pick up a stone and release it, it immediately drops down to earth. So commonplace is this experiment that no one ever seemed to question it for thousands of years. The few philosophers who perhaps did question it, never came anywhere near answering this riddle to their satisfaction.

It continued to be one of the greatest puzzles of all times till the brilliant Sir Isaac Newton in 1687 published his "Principia," giving his explanation of the universal rule of the law of gravitation.

Though the immortal Newton has given us more accurate insight into the mechanics of gravitation than any one man, he died, never knowing *what* gravitation was. In this respect he was much like the equally brilliant Faraday, thanks to whom we have learned more about our most important electrical laws than of any other scientist. He, too, died not knowing *what* electricity was.

It is safe to say that, had Newton lived to-day, he would no doubt have greatly enriched our present knowledge of gravitational phenomena. Unhappily he was born before the days of electro-magnetism, a fact which is to be forever deplored.

Any school-boy can tell the cause of an apple falling from a tree. His answer will be: Because the earth *attracts* the apple.

But *why* the earth should attract the apple, not even Newton could guess; nor could our most able scientists up to a comparatively short time ago.

While Newton's law of Universal Gravitation has stood the test of time, and while it has been accepted by every modern thinker, he thought that gravitation was instantaneous. To elucidate:

Newton imagined that if the earth, for example, due to some titanic cataclysm, should be thrown from her path, the effect would be felt *instantaneously* throughout the entire planetarian system and beyond. We know to-day that this is not the case. Indeed, we know that gravitation requires time to act through space, and the most surprising fact is that gravitation takes as long to travel as light or electro-magnetic (wireless) waves; to be exact, it travels at the rate of 186,000 miles per second, which is the speed of light rays and electro-magnetic waves. Thus, coming back to our imaginary case, if the earth was suddenly thrown from her present path, the effect would be felt on the sun *in eight minutes* after the cataclysm took place, not instantly. In other words, it takes gravitation, traveling at the rate of 186,000 miles a second, eight minutes to bridge the gulf of 92,894,000 miles separating the earth from the sun. A rather startling fact, but true nevertheless.

We know to-day that light is of electro-magnetic origin; as a matter of fact, light rays themselves are electro-magnetic rays. Both are of the same family, the only difference between the two being that light waves are appreciably shorter than electro-magnetic waves.

Because gravitational "waves"—for waves they probably are—travel at the same rate of speed as the other two, the thought lies near that gravitation must of necessity be an electro-magnetic phenomenon. This is but a theory to-day, but it has been generally accepted as correct.

No one has as yet measured gravitational waves, but the day seems not distant when some modern Hertz will open the way for the gravitational Marconi of the future. For it was Hertz who discovered the electro-magnetic (Radio) waves, and Marconi who showed us how to use them outside of the laboratory.

If an indirect proof were wanting that gravitation is really an electro-magnetic phenomenon, we have but to reflect that gravitation acts upon everything imaginable, except on light, heat or electro-magnetic waves.

It has been shown experimentally that gravitation has no effect on light or electricity; in other words, a ray of light or an electric current meets with no more resistance when traveling away from the surface of the earth than when traveling towards it. Thus, the gravitational effect of the moon on the earth is so enormous that it lifts up millions of tons of water, thereby creating our tides. But this immense force has absolutely no effect upon the weakest light ray shot down to earth—and right past the moon—from the most distant star.

To say that light or electro-magnetic waves have no mass, consequently no weight, is begging the question. Newton himself proved that if a body were to be removed out in space so far away that no celestial body would have any influence upon it, that body, though obviously having mass, would be *weightless;* it also would remain freely suspended in space. This fact of course is very obvious.

Man will begin to really live on that day when gravitation shall have been mastered. The day will come when he will make his body weightless, when he can release a stone without it falling down to earth. That day will find him ready to leave the earth in a *real* flying machine, not dependent upon the atmosphere. On that day he will venture forth towards the moon and towards our nearest planets.

Then, and only then, can man call himself emancipated.

H. GERNSBACK.

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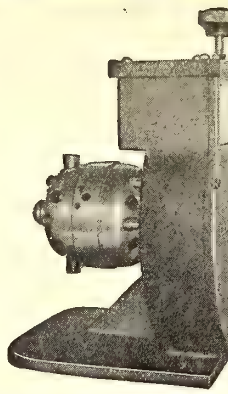

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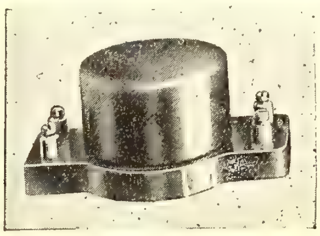

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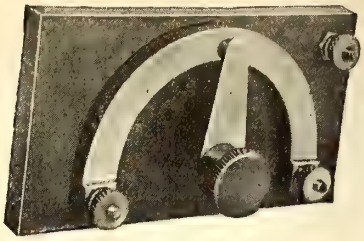

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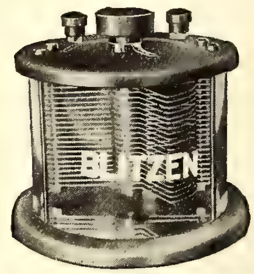

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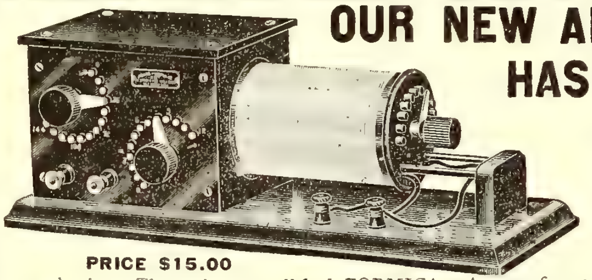

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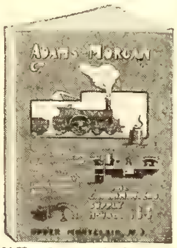

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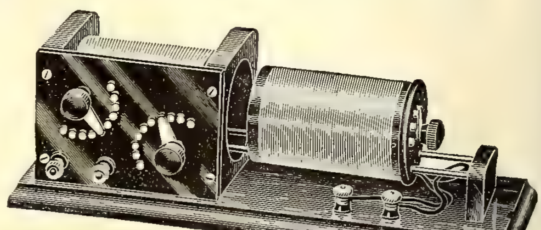

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THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
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Vol. IV. Whole No. 42 OCTOBER, 1916 Number 6

The Electric Villa of a Thousand Wonders

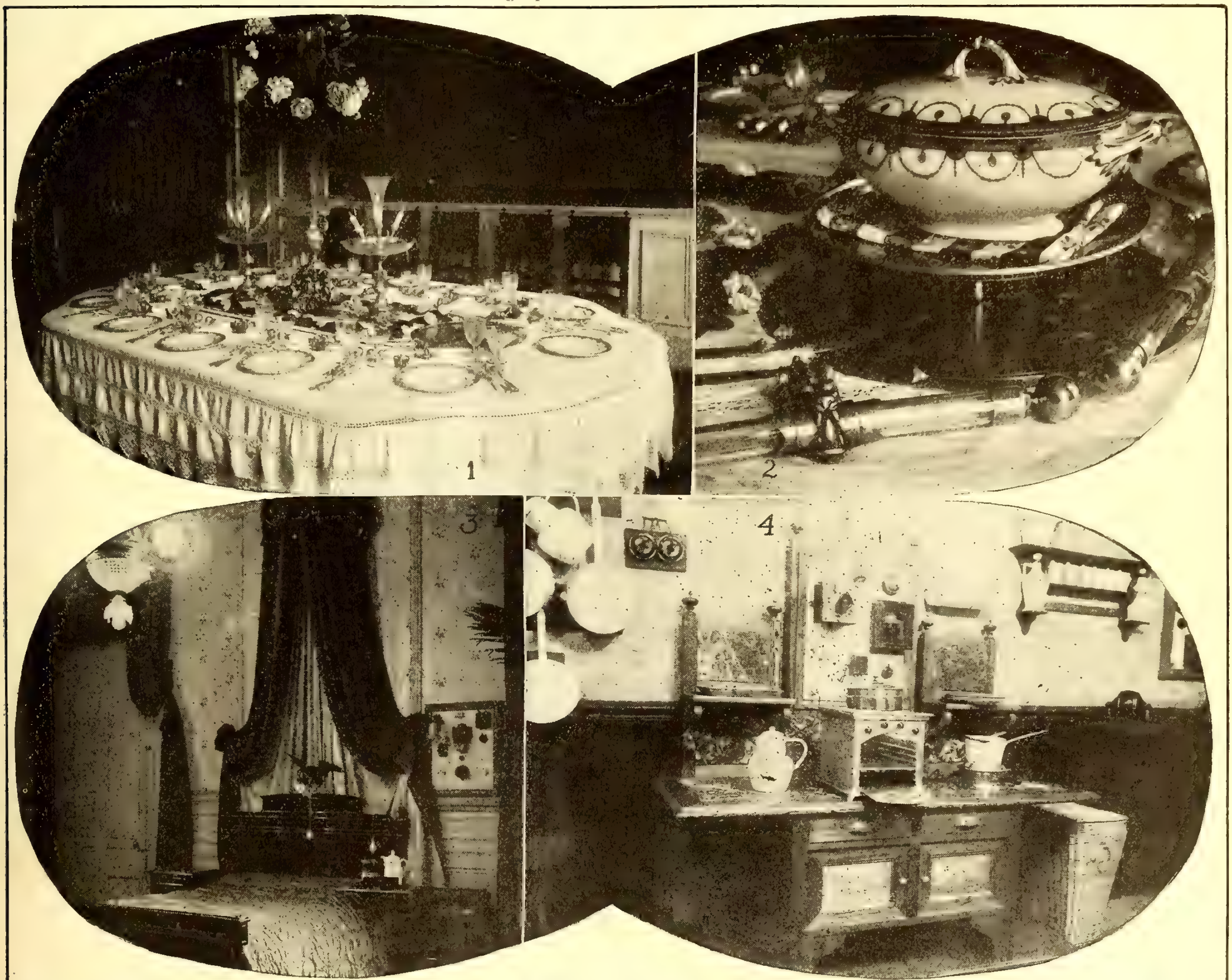
By Jacques Boyer

Paris Correspondent of "The Electrical Experimenter."

HAVING heard of a wonderful electrical mansion in the suburbs of Paris, I straightway decided to visit it and explore its wonders myself.

The name of the owner and builder of this unique and ingeniously constructed mansion is M. Gëorgia Knap. I at once sought his acquaintance and upon expressing my interest in his electrical house, he cordially invited me to visit him upon a fixed date. Accordingly I proceeded to the *Villa Féria Electra.*

Upon my arrival at the outer gate I pushed a button located conveniently near the owner's name. Upon my doing so, a loud though pleasant voice emanating from one of the stone pillars interrogated me as to my name and business. Having tendered this information and having been bid "welcome," the massive iron gate before me opened silently and as I passed through the archway to the magnificent gardens surrounding the house, the voice bade me to refrain from closing the gate, as it would do so of itself—and it did, much to my amusement.



A Wonderful French Electrical Mansion. 1. The Dining Table Served Entirely by Electricity from Kitchen Below. 2. This Dish Has Just Arrived from Below and Travels from Guest to Guest. 3. The Electrified Bed Chamber, Provided with Self-Closing Windows and Curtains. 4. The Chef's Domain, Where Electricity Boils the Eggs and Broils the Chicken Automatically.

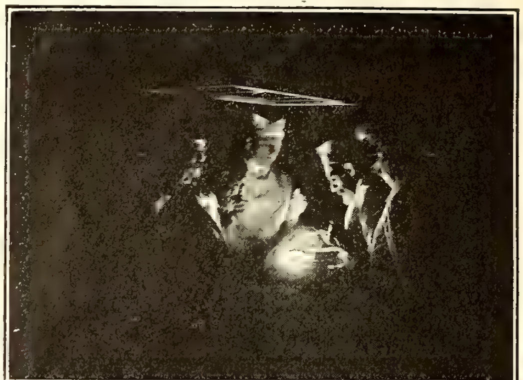
I reached the porch of the mansion directly, and as I stepped upon the floor the front door opened automatically. And still no human being appeared to welcome me. It truly was a most remarkable experience—though by this time somewhat disconcerting.

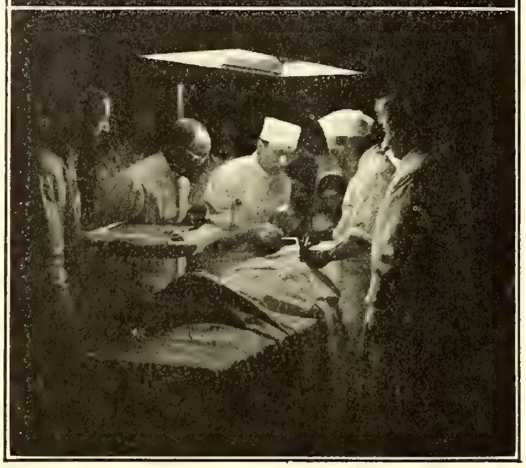
X-RAYS AND RED LIGHT AID MODERN SURGEON.

TO Professor J. Bergonié of Bordeaux, France, the medical world owes in a large measure many of its latest improvements in electrical and allied devices. One of his remarkable discoveries is the fact that if the operating room, or rather the patient to be operated upon by the surgeon, is first illuminated with a pure red light as in the illustration herewith shown, with intermittent inspections by the usual X-Ray, that practically no eye fatigue became noticeable in the transition from the red illumination to the greenish X-Ray fluorescence.

The surgeon working under ordinary lighting conditions with the X-Ray, especially where it is to be used in conjunction with an operation, experiences difficulty in quickly perceiving the fluoroscope screen image. The new method of Bergonié is based on the law of simultaneous contrasts of colors or on the simple phenomenon known to most school boys and girls that, if the eyes are allowed to rest upon a certain color or shade for a few moments, then the eyes will retain this impression for several seconds when they are turned away from the color. This effect is termed the *persistence of vision* and owing to this phenomenon it is possible for us to have the modern motion picture. Each picture in the modern movie lasts for about one-sixteenth of a second, and if the retina of the eye could change faster than this with respect to the luminous impression made upon it by each successive picture, then we would not be able to enjoy the present motion picture at all, as we would see each *individual scene* as it is rapidly projected on the screen.

Several odd phenomena of this nature occur, as for instance when you gaze at a red disc and then turn to a similar disc of pure white the latter will appear to have a greenish tint. Again it will be found that if the second disc, instead of being white, happens to be of a greenish shade, it will be noticed that the green is intensified by the green impression made by the red vision. In a like manner if the eyes are fixed on the red disc its color will be intensified with the red impression transmitted to the retina of the eye by the green disc; the two colors thus reciprocally improve each other. These facts have been utilized in working out the new system of surgical illumination by Professor Bergonié and satisfactory results are claimed for it.





Photos from Jacques Boyer

Using the Red Light in Conjunction with X-Rays for Surgical Operations to Enable the Surgeon's Eyes Becoming Accustomed to the Change in Light More Readily. Top View—Using X-Ray on Patient; Below—Using the Red Light.

The surgeon in using this system of illumination stands in a darkened chamber and only the pure red illumination above the operating table is used. Thus the sensibility of the surgeon's eyes is well conserved and may even be increased in the course of the operating period. Now, when the X-Rays are thrown on from beneath the operating table to aid the surgeon and his assistants in exploring the portion of the body being operated on, they are able to perceive very quickly and without any loss of time, the fluoroscopic images of the bones, which appear in a greenish tint. In other words, the retina of the eye accommodates itself not only quickly but efficiently, to the change in color of the illumination. Usually there are but a small number of X-Ray inspections necessary during the progress of the surgical operation. In one case where a piece of shrapnel had to be extracted from a man's heel, two radiographic examinations were necessary. The time period of fluoroscopic inspections required hardly ever cover a period longer than thirty seconds and seldom this length.

In another case where a shrapnel splinter was dislodged from the region of the thigh bone and four inches below the surface of the flesh, necessitated six radioscopic inspections. This always depends of course upon the build of the patient, a thin person naturally requiring a less number of such examinations than one of extreme muscular development.

The dome over the operating table as shown in the accompanying illustration is about the same size as the table itself, to avoid casting shadows on the patient, and is lighted by about twenty twenty-five candlepower lamps placed behind a sheet of pure red glass.

An electric apparatus for washing smoke has been perfected to relieve cities of the smoke nuisance. The smoke is driven by fans through a column of water which washes out the soot and cinders. Pittsburgh papers please copy!

Instead of the human welcome, which I still looked forward to, a peculiar scraping motion at my feet arrested my attention and I found that my boots were being cleaned by a set of electrically operated rotary brushes.

And at this juncture, Monsieur Knap himself appeared to welcome me in the name of the *Villa Féria Electra*. It became evident from my host's manner that he was a thoroughgoing Frenchman, some forty-eight years of age, and, as I presently learned, hailing from the city of Troyes.

We first visited the inventor's marvelous electrical laboratory where there were a hundred and one different apparatus, many of which I had never seen or even heard of before. Surely this man must be an investigator of electrical matters to a very thorough degree. How correct I was in this assumption was to be impressed upon me more than once during my short but profitable stay.

The next point of interest proved to be the dining-room of the Villa, which, although not of large dimensions, was most elegantly furnished. The dining-room table, which resembled a larve oval, was at first glance an ordinary one. But M. Knap demonstrated shortly that it was not that. No *garçon*, no matter how polished or elaborate his poise, ever reaches this apartment. Electricity performs all the multifarious duties of waiter and butler for the serving of the food and wine in a most efficient yet quiet manner.

In the illustration herewith showing the table the tubes just back of the table's edge are miniature *gates*, which serve to prevent the guests at the table from inadvertently pushing any dishes onto the moving belt system by which the dishes progress around the table from one guest to another.

The soup, for instance, is sent up by the Chef from the kitchen in a tureen which appears before the host. He serves himself to a plate of soup and the tureen then moves along to the next guest, who also avails himself of his portion. The napery, cutlery, et cetera, are sent up from the kitchen in a small basket, which travels around the table in the same manner as the soup tureen.

M. Knap then proceeded to show me how orders were given from the dining-room to the kitchen or other servant's quarters, by a portable switchboard in the form of a tabouret, which can be wheeled about the apartment to any desired position. By simply pressing a button on this switchboard the illuminated decorations were brought into play, showing a handsome statue at one end of the room. Also beautiful artificial flowers, as shown by the illustration herewith, were lighted, forming a perfect garland about the table.

After we had been shown how the various courses were sent up to the table, at the conclusion of the meal a turn of a switch demonstrated another novelty in the form of an electric blower, which wafted a current of perfumed air through the room.

Should one of the guests suffer from cold feet while he is at dinner, he has simply to press a foot stool button, when it would become electrically heated in a short time. It was explained that electrical heaters were used throughout the dwelling and controlled by means of automatic thermostats placed in the various halls and apartments.

From what I had already seen, I was more than anxious to see the processes of the culinary department and so my host conducted me to the kitchen below. It was quite obvious, upon my entrance, that no coal or ashes were used here. Electricity

(*Continued on page 449*)

DATE OF ISSUE.—*As many of our readers have recently become unduly agitated as to when they could obtain* THE ELECTRICAL EXPERIMENTER, *we wish to state that the newsstands have the journal on sale between the fifteenth and the eighteenth of the month in the eastern part of the United States and about the twentieth of the month west of the Mississippi River. Our subscribers should be in possession of their copies at these dates. Kindly bear in mind, however, that publications are not handled with the same dispatch by the Post Office as a letter. For this reason delays are frequent therefore kindly be patient and do not send us complaints as to non-arrival of your copy before the twenty-fifth of the month.*

When the Engineers Go to War

THE engineer in time of war, no less than in time of peace, is always in a position to accomplish some valuable work for his country. Unlike the soldier of ordinary attainments, it is possible for the technically trained man to be of inestimable assistance to the general staff of the Army and Navy, who are responsible for the defense of the country at all times. It is only in the past year that due recognition has been given to technical experts in all branches of applied science throughout the country to show what they really can accomplish in a military way.

One of the most important innovations ever made in this direction was that by Secretary Daniels of the Navy, incorporating the new Naval Advisory Board. All of the leading engineering societies in the United States were asked to co-operate in selecting suitable members for this Advisory Board, with the consequence that we now have a unified staff of technicians, capable of giving thoroughly satisfactory and expert opinions on any electrical, civil or mechanical problem that may arise in the development of new war machinery.

There has recently been organized a complete staff of civilian engineers throughout the country who are assigned to the preparation of *purchasing schedules,* to be used in time of military stress. These concern the details of purchasing military supplies, the cost and time of delivery. Thus it is seen that the civilian engineer may be of great value to the country, without being obligated in any way, as far as military connection is concerned.

On the other hand, we have the professional military engineers, which include men who have climbed up to various high positions, particularly those graduated from the government naval and army schools. The naval experts are graduated from the U.S. Naval Academy, at Annapolis, Md., while the army military engineers graduate from the excellent school at West Point, on the Hudson. This school is one of the best in the world, and has received high commendation from the greatest military experts of Europe, who have happened to visit this interesting institution.

The U.S. Military Academy at West Point gathers its students from all over the United States and its possessions, under the following rules and requirements:

Each Senator, Congressional District and Territory, including Porto Rico, Alaska and Hawaii, is entitled to have one cadet at the academy; the District of Columbia, two cadets. There are also forty appointments at large, specially conferred by the President of the United States. The law (act of March 4, 1915) provides that until the appointment of Representatives in Congress among the several States under the Fourteenth Census of the United States becomes effective (March 4, 1923), whenever any cadet shall have finished three years of his course at the academy his successor may be admitted.

Appointments are usually made one year in advance of admission, by the Secretary of War, upon the nomination of the Senator or Representative. These nominations may either be made after competitive examination or given direct, at the option of the Representative. The Representative may nominate two legally qualified second candidates, to be designated first and second alternates. The alternates will receive from the War Department a letter of appointment, and will be examined with the regular appointee, and the better qualified will be admitted to the academy in the event of the failure of the principal to pass the prescribed preliminary examinations. Appointees to the Military Academy must be between seventeen and twenty-two years of age, free from any infirmity which may render them unfit for military service, and able to pass, unless a satisfactory certificate is submitted, a careful examination in English grammar, English composition, English literature, algebra through quadratic equations, plane geometry, descriptive geography and the elements of physical geography, especially the geography of the United States, United States history, the outlines of general history. The Secretary of War is authorized to permit not exceeding four Filipinos, to be designated, one for each class, by the Philippine Commission, to receive instruction at the United States Military Academy at West Point; *Provided* That the Filipinos undergoing instruction shall receive the same pay, allowances and emoluments as are authorized by law for cadets at the Military Academy appointed from the United States, to be paid out of the same appropriations: *And provided further,* That said Filipinos undergoing instruction on graduation shall be eligible only to commissions in the Philippine Scouts; serve for eight years, unless sooner discharged.

Photos Copyright by Underwood & Underwood.

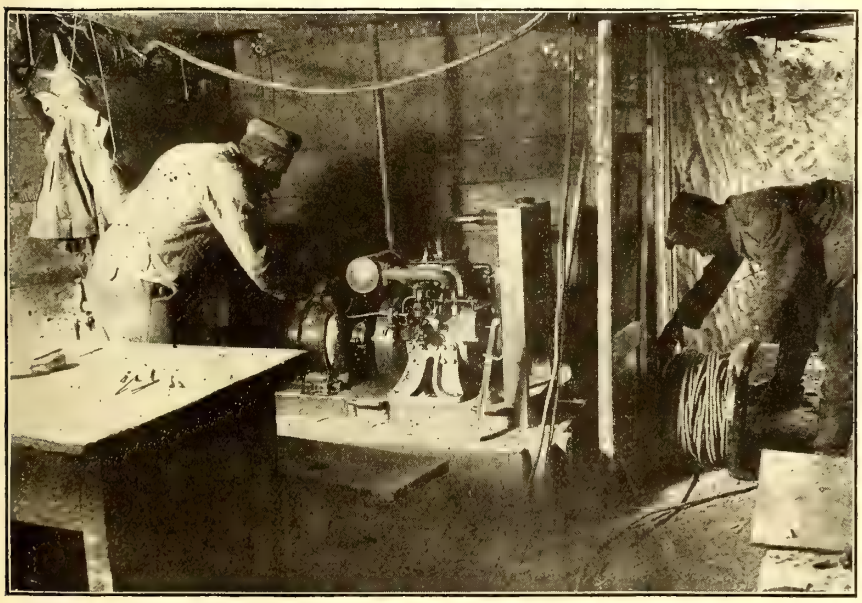
German Military Engineers Engaged in Mining a Bridge. At the Push of an Electric Button This Mighty Structure Will Be Blown to Atoms.

The course of instruction, which is quite thorough, requires four years, and is largely mathematical and professional. The principal subjects taught are mathematics, English, French, drawing, drill regulations of all arms of the service, natural and experimental philosophy, chemistry, chemical physics, mineralogy, geology, electricity, history, international, constitutional, and military law, Spanish, civil and military engineering, art and science of war, and ordnance and gunnery. About one-fourth of those appointed usually fail to pass the preliminary examinations, and but little over one-half the remainder are finally graduated. The discipline is very strict—even more so than in the army—and the enforcement of penalties for offences is inflexible rather than severe. Academic duties begin September 1 and continue until June 4. Examinations for cadets not having made satisfactory progress in studies are held in each December and June, and cadets found proficient in studies and correct in conduct are given the particular standing in their class to which their merits entitle them.

From about the middle of June to the end of August cadets live in camp, engaged only in military duties and receiving practical military instruction. Cadets are allowed but one leave of absence during the four years' course, and this is granted at the expiration of the first two years. The pay of a cadet is $709.50 per year, and, with proper economy, is sufficient for his support.

Upon graduating, cadets are commissioned as Second Lieutenants in the United States Army. The whole number of graduates from 1802 to 1915, inclusive, has been 5,476. It is virtually absolutely necessary for a person seeking an appointment to apply to his Senator or Member of Congress. The Superintendent is Colonel Clarence Page Townsley, Coast Artillery Corps, U. S.A., and the military and academic staff consists of 134 persons.

(*Continued on page 450*)



Another Phase of Military Engineering—A Trench Electric Generating Plant, Many of Which Are Near the Firing Line.

Electrical Frauds

By H. Gernsback

EVER since the advent of static electricity in the Seventeenth Century, the public has been made to believe by irresponsible *pseudo* scientists, that the mystic fluid was to be the cure-all for every disease and every ailment of a long-suffering humanity. Not that the early form of static machine had not certain therapeutic qualities. It had, and so has the modern static machine now in use by thousands of reputable physicians. Static electricity as applied to a patient by a physician will greatly stimulate the nerve centers and it is particularly efficacious in the treatment of neurasthenia and neuralgia, as well as certain forms of rheumatism, etc. A *cure*, however, is rarely effected.

When galvanic electricity was discovered in the early part of the Nineteenth Century, the public was still further aroused as to the curative value of modern electricity and magnetism and it did not take long for the unscrupulous quacks to find out that here was indeed a gold mine to be extracted from the unsuspecting, suffering public.

We have no desire to condemn the medical coil, the modern high frequency apparatus, nor the faradic current devices, all of which have therapeutic value and while perhaps seldom effecting cures, nearly always bring relief to the patient if used intelligently.

We do, however, condemn the use of a certain class of devices foisted upon the unsuspecting, devices for which the most preposterous claims are being made. It is true that such devices are perhaps not so widely sold nowadays as two or three decades ago, as they can no longer be advertised in respectable publications. Notwithstanding this, it has been a constant source of wonder to us how much of this material is still being sold every day throughout the world, particularly in the United States A visit to certain second-rate drug stores and certain questionable stores selling trusses, belts and the like, will be a revelation to the man who thinks the entire world enlightened.

And we do not even put the entire blame on these particular store keepers. Most of them probably are laymen themselves as far as electricity is concerned, and a few perhaps believe that the devices which they sell will do what the manufacturers claim for them. So why not sell them? The others who really know, realize that the articles will not hurt anyone and to square themselves with their conscience, assume the attitude of *benevolent auto-suggestion*. They know that many ills have been cured by sugar-coated bread pills! If only the wearer of the appliance *thinks* that it will help him, it probably *will* do him or her some good. So why worry, as long as there is no law forbidding the questionable traffic?

Perhaps the most widely advertised electrical frauds were the "electric" belt, as shown in our figure 1 and the "electrical" trusses and arch supporters shown in figure 2. The cruder form of these devices usually have small round copper and zinc (or copper and silver) plates attached to the inside of the belt which are supposed to lay flat against the skin of either the abdomen or the back, or both. The perspiration of the skin is supposed to act as energizing fluid (electrolyte) and thus is supposed to close the current, as the copper discs are connected to the zinc or silver discs by a wire in the inside of the belt. A formidable current is thus guaranteed to be set up between the discs which, amongst others, will cure the following, taken from the manufacturer's pamphlet: rheumatism, neuralgia, liver and kidney troubles, lumbago, constipation, piles, lame back, poor circulation, nervous, restless nights, incipient paralysis, numbness, prickly sensation, dizziness, tired feeling in the morning, indigestion, weakness and general debility, fits, costiveness, indigestion, spinal weakness, lack of vital force, decay in old or young, all cases where there is a lack of animal electricity. It is a pity that the manufacturers did not include in the list compound fracture of the skull! It is so complete otherwise!

Few people who have a knowledge of electricity would think it possible that the lay public at large is still being exploited day after day, with the class of merchandise described in this article.

Perhaps you think that "electric" belts, magnetic finger rings, "electric" insoles, etc., have long ago disappeared from the surface of the earth. If that is your opinion look around in your town, in certain stores. You will be surprised at the result.

Although this is the Twentieth Century, "there is one born every minute," even in this enlightened age. P. T. Barnum was right: The people want to be fooled!

Now, of course, every student of electricity knows that the current that can be set up between a copper and zinc or a copper and silver disc, using a weak acid (perspiration) as an electrolyte, will never be much above three-fourths of a volt. The current is probably never more than one-fourth ampere in the best of these belts. Now, if this current was steady the belt would at least produce an uninterrupted flow of electricity. Unhappily, due to what is known as polarization, the current in less than one minute drops to almost zero and the "electrical" belt, as far as electricity is concerned, might as well be a plain leather belt; the latter gives almost as much electricity and costs less.

WATCH FOR THE NOVEMBER "E.E."

It will usher in the electrical season of 1916-1917 with a wealth of valuable articles of extreme interest to all of our readers. We have in preparation among other things the following:

- *"Uncle Sam's New Electric Battle Cruiser—A Forty-Mile-Per-Hour, Sixteen-Inch Gun Super-Dreadnaught."*
- *"Tesla's Artificial Lightning."*
- *"The Wonderful Belin System of Transmitting Pictures Over a Telephone Line."*
- *"Long Range Gun Spotting With Aeroplanes and Radio."*
- *"Back in the Palmy Days—When Wireless Was Young." By H. Scott.*
- *"Electricity and Its Use in Treating Infantile Paralysis."*
- *"A Portable Electric Plant Used in Making the Movies."*
- *"Recent Developments in Practical Radio-telephonic Apparatus." By Samuel Cohen.*
- *"The Spark Coil—How It Works and Why."*
- *"Experimental Chemistry Course." By Albert W. Wilsdon.*
- *"Marvels of Modern Physics." By Rogers D. Rusk, B.Sc.*

More discs of course do not help generating more current. Thus the "electrical" truss shown in figure 2 gives actually *less* current, though it has several copper and several zinc discs. The idiocity of this construction is particularly violent. Here one copper disc touches a zinc disc, the latter then touches a copper disc and this again touches a zinc disc, etc., etc. Now as soon as the perspiration of the foot touches these plates (the entire surface of the foot being a conductor, due to the perspiration) *all* the discs are, of course, short-circuited immediately! There may be set up a *momentary* current in the thin film of the perspiration, but it never will enter the foot itself. As for curing cold feet and rheumatism, an ordinary sock or stocking is just as efficacious!

Then there is the more pretentious "electric" belt having "batteries" stowed away in its lining. These batteries are again the copper-disc, zinc-disc variety, with felt pieces between the discs. The cells are connected in series by wires. The whole battery is dipped in weak sulphuric acid and is guaranteed to give a powerful current, curing all sorts of ills. This belt as far as electricity goes, works the same as the one described already. No zinc-copper or zinc-silver battery, moistened with a weak acid can give a steady current. The voltage drops in all cases to almost zero in less than one minute. The longer the belt is used the worse it gets and the only powerful act it does is that the acid occasionally burns holes in the underwear and clothing!

The "electric" chest pad, figure 3, is in the same category as the "electric" belts. It is greatly to be recommended for soldiers in the trenches, where it might stop a weak-minded bullet, but as far as electricity is concerned its functions are nil!

The "electric" hair pad, shown in figure 4, is another worthy member of the "electric" belt and insole family. The most it will ever do is that it will cause abnormal perspiration of the head, due mainly to a lack of air circulation. For producing headaches it is highly recommended.

Growing hair on a bald head is a fascinating indoor sport. Victims are born by the million and the older and wiser they become the harder they fall for hair "restorers." Electricity, the cure-all, as a matter of course comes willingly to the rescue. Electricity enlivens the dead cells and sneaks around the extinct hair-papilla taking it unawares, so to speak. A luxurious growth of hair is the immediate result! We do not wish to go on record by stating that electricity might not grow hair under favorable circumstances, but we have grave doubts as to whether it is ever the direct cause of actually growing hair.

At any rate we firmly believe that the "electric" hair grower as pictured in figure 5 never grew hair. No, it was not sold in

(Continued on page 453)

(For details see text on opposite page)

A Trip Through a Modern Research Laboratory

By Samuel Cohen

THE alchemists for centuries have been laboring in their ill-fitted laboratories to change base metals to gold. To-day this notion is ridiculed, but the laboratories of our modern research workers perform far more wonderful marvels than was ever dreamt by the boldest alchemist. The old chemists left their bottles here and there, tools flung about, with no system whatever. Their only concern was to obtain gold from the baser metals such as lead and iron. To-day, however, the scientific men who are engaged in laboratory work, find it of extreme importance to systematize everything before starting to work and if it is a large laboratory wherein a number of scientists are engaged in research work, they at first cooperate together and classify each certain branch of work that they are to perform; if one of the men is inspired by an idea, the first thing he does is to sketch it out on paper. He then gives the plan to a model maker, who produces his model; it is then placed in the hands of the laboratory assistants, who thoroughly try out the device and finally, if it is successful, it is patented and put on the market. In this way inventions can be most successfully developed. There are several such laboratories where the routine of the different scientists is systematized, all of whom work together under a directing staff of able technicians. The author recently made a trip through the Western Electric Company's laboratories, which is perhaps the most completely equipped and most highly systematized laboratory in this country.

The work that this company conducts is mostly in telephony and telegraphy. The laboratory is divided into different departments, several of which will be here described.

The first department which the author was shown was the research section. Here a large number of scientists work together to develop entirely new apparatus for different lines of work. It was in this section that the wonderful radio telephone apparatus, used in the recent long distance test between Arlington, Hawaii and Paris was developed. It will be of interest to note that several engineers have been employed for a number of years exclusively on radio telephone instruments. In another branch of the engineering laboratories the telegraph typewriter was developed.

We passed on to the circuit laboratory. There were instruments of great variety lying about the different tables, some of which were connected together to correspond to a special problem to which the engineer in charge had been assigned. Thousands of circuit combinations are tested here and new experimental circuits are actually set up and operated to determine their adaptability to the requirements of practical work. Fig. 1 shows a corner of the circuit laboratory. The testing switchboard, in the rear of the room, is so connected that it contains all of the commonly used standard circuits, arranged in such a way that the special circuit under test can be easily connected and operated under actual working conditions. As part of the equipment of the laboratory, artificial lines and cables are provided for the study of long distance transmission.

Then came the refrigerating plant, where materials are tested under very low temperatures and their physical properties studied. In another room are located the high temperature furnaces, in which metals and other substances can be raised to about 3,000 degrees Fahrenheit. Such extremities of heat are at times required to disassociate compounds, into their constituent parts, or else to enhance certain properties of two or more substances so as to make them combine.

The next room inspected was the telephone transmitter laboratory. In this department every new carbon grain transmitter that is being developed and made is thoroughly tested. Several of them are placed in a group and turned over to an assistant, who is given instructions by the

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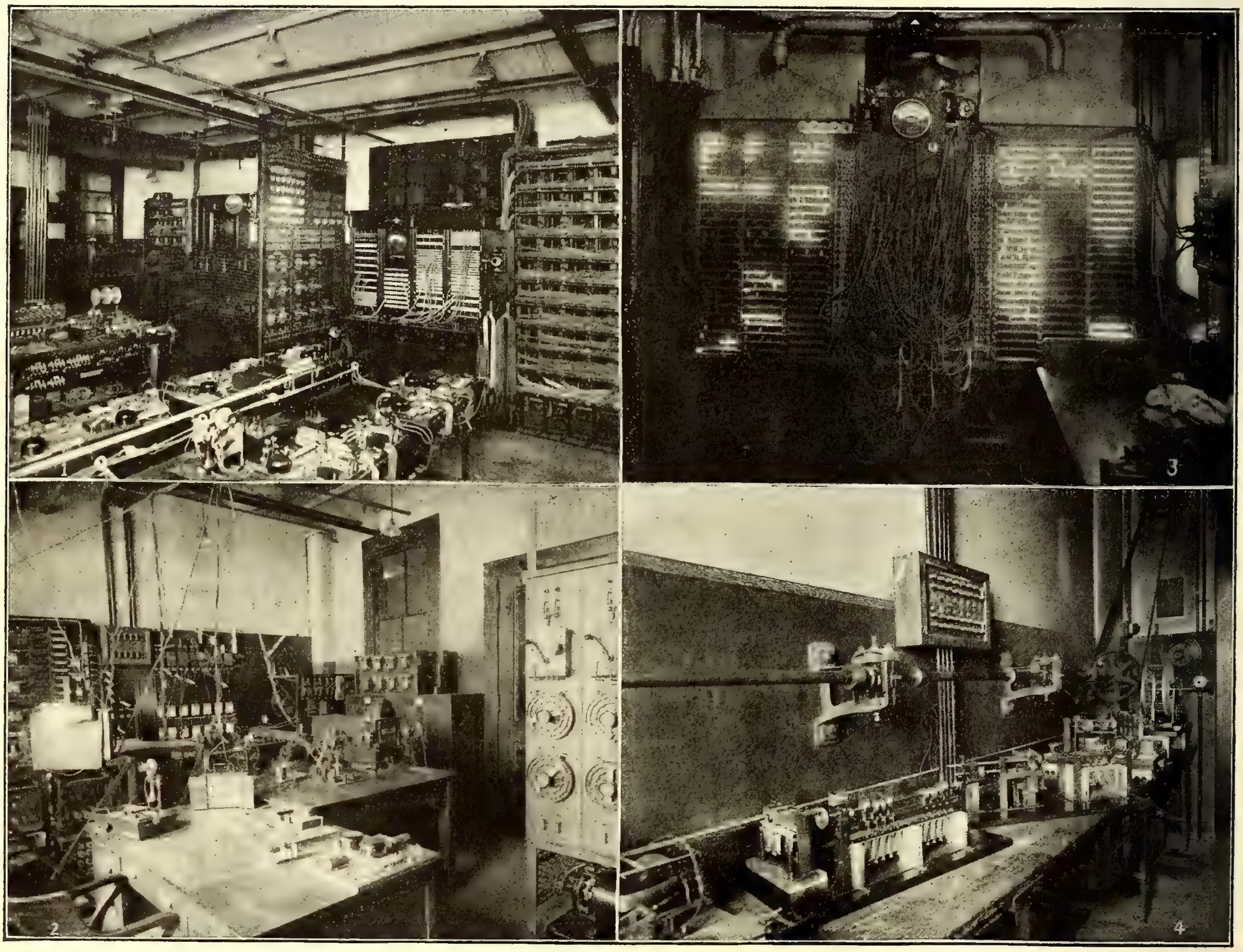
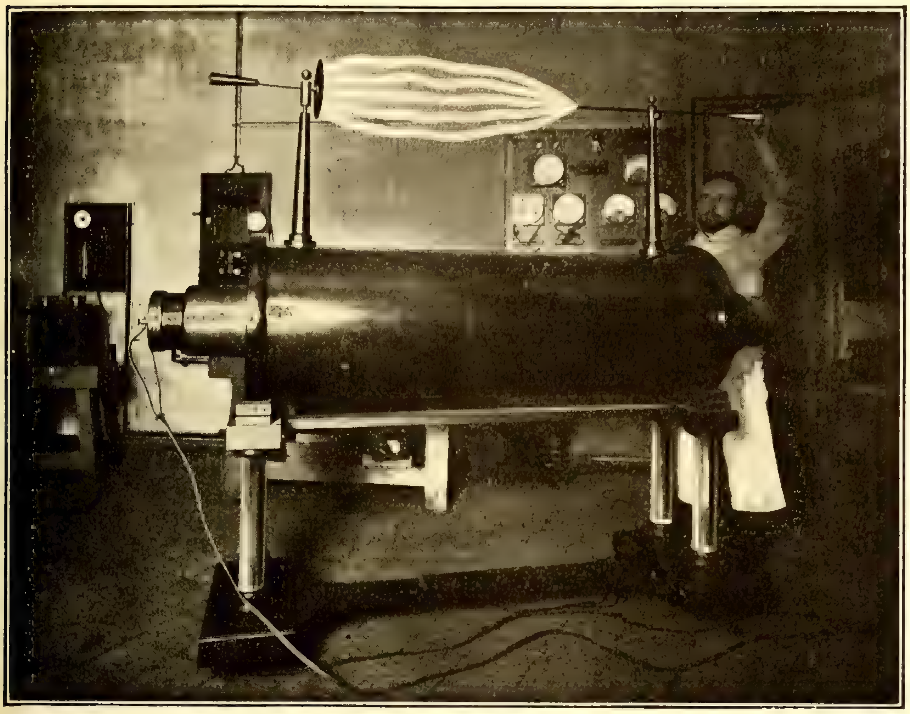


The Expense of Telephone Testing and Research Can Be Judged from the Complex Apparatus Installed in the Laboratories. Only the Great Volume of Telephone Calls Makes Up for the Cost of Perfecting Such a Telephone System as that Extending Over the United States.

GIANT SPARK COIL GIVES 48 INCH DISCHARGE.

A massive spark coil recently constructed in France by the well-known firm of Carpentier, Paris, produced crashing sparks 1¼ meters in length or about 48.75 inches, when operated on a 110 volt D. C. circuit. A mercury interrupter was utilized to break up the primary current of 30 amperes.



Mighty Spark Coil of French Design which Yields Sparks 48 Inches Long. Primary Current of 30 Amperes and 110 Volts, Direct Current was Broken by a Mercury Turbine Interrupter.

The coil proper is supported on glass legs to thoroughly insulate the windings and terminals from ground leakage. The potential of the secondary spark amounts to over a million volts (maximum value). The coil frame is mounted on casters so that it can be moved about at will.

The primary, comprising the laminated iron core and winding, measures 79 inches in length. The core has a cross-section of 60 square centimeters or 9 square inches. The winding consists of 792 turns of wire wound in six sections, the diameter of the wire being No. 18 B. and S. gauge. The primary coil is encompassed by an ebonite (hard rubber) tube 79 inches long by 6/10 inch thickness of wall.

The secondary winding involves the tremendous length of 97½ miles of insulated copper wire No. 32 B. and S. gauge.

CANDLEPOWER OF A FIREFLY'S LIGHT.

Calculating the candle-power of a firefly's light is no easy matter, especially as it shows its brightest light only when in flight; but William H. Pickering of the Harvard Astronomical Station at Mandeville, Jamaica, managed to do it by comparing it with the light of certain stars. The Jamaican firefly gives a brighter light than those with which we in the States are familiar, and Pickering's calculations are for that of the tropical insect. In a recent letter to *Nature* he states that:

"A great number of them fly along a neighboring road, and their position can be determined by their illumination of the inclosing stone walls. Their brightness was found to equal that of the star Canopus, which was just over the road and at rather a low altitude. Its brightness was at that time equal to Orionis, the altitude of which was 40 degrees. It was a very clear evening, as is generally the case here, so that we may take the brightness of the latter as of 1 magnitude. The distance of the road was 175 feet, or 53 meters. A zero magnitude star is equal to one candlepower at 526 meters. If of zero magnitude the light of the firefly would therefore have been just 0.01 of a candlepower. Being of first magnitude, its light was 0.004 candlepower. This result is probably correct within half a magnitude, or 50 per cent, and considering the apparent brilliancy of the insect, is smaller than one would have expected. The writer is not aware of any previous measures of this quantity."

FREAK CAUSES OF TELEGRAPH LINE TROUBLE.

Lineman George Worzel, when stationed at Lackawaxen Pike County, Pa., away back in the olden days, would frequently report the cause of line trouble on his section as due to "bears" breaking through the line on mountain sides, says *Telegraph and Telephone Age*.

Mike Mather, lineman, stationed at Jersey City, N.J., back in the eighties, once reported No. 3 Lackawanna crossed with a German band in Hoboken.

Jim Doyle, lineman, stationed at Fort Lee, N.J., when that place opposite One Hundred and Thirtieth Street, New York, was the Monte Carlo of this continent, would lasso black snakes along the then wild Palisades, throw them across the loop line leading into the horse racing pool rooms, thus causing them to be "crossed out," and after worrying the "bookmakers" for a few minutes, march like a hero to the spot, remove the cause of trouble and collect ten dollars from each of his dupes.

Pete Yensen, stationed at Kansas City, some years back, reported a district call box cut by Carrie Nation's hatchet during one of her raids.

Now Mike Keefe, lineman stationed at Huntington, Ind., reports under date of July fifth, as follows: "No. 257 broke west of Akron, Ind., grounding 262 and 617, caused by a man in a parachute dropping on the line. OK 11:25 a.m." Thus the wire chief's and linemen's worries are constantly multiplying.

THIS BEE DRILLS THROUGH LEAD.

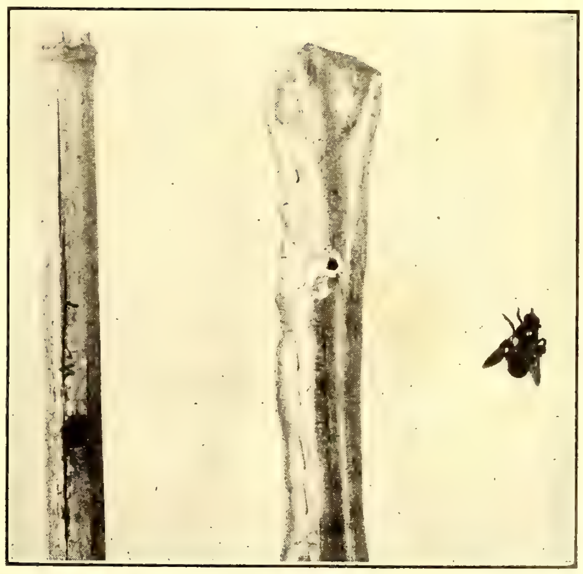
For some years it has been suspected that a sort of beetle was the cause of holes found scraped in the lead sheath of aerial telephone cable in China. But a bee is the culprit, says a writer in the *Western Electric News*. Philip H. Cole, engineer-in-chief of the Shanghai Mutual Telephone Co., China, who visited Hawthorne recently, tells us about this remarkable insect.

It seems that the Wood Cutter Bee uses the bamboo as a place to lay eggs. Her ordinary procedure is to scrape a hole in a living bamboo, crawl inside, lay her eggs and die. The eggs hatch out and the progeny live on the parent's body until strong enough to crawl out and fly away. This bee mistakes the round, smooth, lead sheath of a telephone cable for a bamboo and attempts to follow the same process with it as she does in the case of a living bamboo tree and actually scrapes a hole in the lead sheath. This, of course, lets water in. When she finds that the cable is full of paper and copper, she abandons the job and either scrapes another hole in the lead cable somewhere else or locates a bamboo grove in the neighborhood.

Dr. Cole has observed this insect working both on the cable and on bamboo stalks. He took a specimen of the bee to the North China Branch of the Royal Asiatic Society and that organization gave him the following classification:

"Wood Cutter Bee (Xylocopa Violacea). The insect is a genuine bee, one of the family hymenoptera."

Mr. Cole has observed that where the bamboo groves have been cut away from the neighborhood of the cable that the difficulty has disappeared.



Here is a Real Busy "Bee" That Likes to Scrape Holes Through a Bamboo Stalk so as to Lay Her Eggs Within It. The Bamboo is Seen at the Left But Just See What Her Bee-ship Did to the Lead-covered Telephone Cable at the Center.

The Feminine Wireless Amateur

JUST because a man, Signor Guglielmo Marconi by name, invented commercial wireless telegraphy does not mean for a moment that the fair sex cannot master its mysteries. To prove that the girls and women of the country are rapidly awakening to the fact that radio operating is a worth-while accomplishment, both vocationally and intellectually, we have the pleasure of presenting herewith a number of photographs showing the Radio activities of our fairer sex.

Allow Us to Present Miss Kathleen Parkin, Expert Radio Operator at Fifteen Years of Age. She Has Made Her Own Apparatus.

First we wish to introduce Miss Kathleen Parkin of San Rafael, California, who, though only fifteen, is an expert radio operator and mechanician, and one of the youngest, fully qualified ladies we have had the pleasure of reporting. We felt so enthusiastic over the sentiments set forth in Miss Parkin's interesting communications on the subject that we had our artist reproduce her ladyship at the key, in full colors for our front cover. The original photograph is reproduced on this page. She recently received a first grade commercial radio operator's license from the United States Government. Her call is 6 S O and Miss Parkin says she will be pleased to communicate with any amateur within range. Here is the chance for budding Radio Don Juans to kill a rainy evening, without even getting their feet wet. Bashful amateurs, please take notice!

Miss Parkin writes logically, although she is young in years, to wit:

With reference to my ideas about the wireless profession as a vocation or worth-while hobby for women, I think wireless telegraphy is a most fascinating study, and one which could very easily be taken up by girls, as it is a great deal more interesting than the telephone and telegraph work, in which so many girls are now employed. I am only fifteen, and I learned the code several years ago, by practising a few minutes each day on a buzzer. I studied a good deal and I found it quite easy to obtain my first grade commercial government license, last April.

It seems to me that every one should at least know the code, as cases might easily arise of a ship in distress, where the operators might be incapacitated, and a knowledge of the code might be the means of saving the ship and the lives of the passengers. But the interest in wireless does not end in the knowledge of the code.

You can gradually learn to make all your own instruments, as I have done with my ¼ kilowatt set.

There is always more ahead of you, as wireless telegraphy is still in its infancy.

Miss Parkin is beginning her third year of high school at the Dominican College, San Rafael, where a small wireless set has been installed for the instruction of the physics class.

Miss Graynella Packer, a young woman of Jacksonville, Fla., whose photograph is shown on the opposite page, has gained for herself the distinction of being the first woman wireless operator to serve aboard a steamship in a commercial capacity. She has served aboard the Clyde liner, *Mohawk*, in full charge of the wireless. She has greater things in mind, however, and it is her ambition to handle atmospheric electricity aboard some of the big ocean liners. Miss Packer was for two years a telegraph operator at Sanford, Florida. She had a number of amusing and unique experiences on various trips along the Atlantic seaboard, including among other things some highly efficient examples of seasickness, the ship rolling about like a nutshell in a washtub, when the vessel endeavored to navigate a heavy storm off the Carolinas. But she stuck to her post, like all good radio operators, and awaited at all times the captain's orders to flash a message via radio.

Wireless telegraphy instruction was a special feature of the work done in a girls' camp at Rowayton-on-the-Sound, Conn., this summer. Mrs. Josephine Craw, of Craw Avenue, Rowayton, gave the use of eighty-eight acres for the camp, which was in charge of Mrs. M. E. Hamilton and which was indorsed by the National Special Aid Society of 259 Fifth Avenue, New York City, where Mrs. Hamilton has headquarters.

There is a demand for women wireless operators, and they are particularly preferred as wireless operators in department stores, where there is an increasing demand for them. The girls at the camp were instructed first by communicating with motor boats on the Sound, and as they became proficient they operated larger apparatus and communicated with regular radio stations.

We show here two views of the women being instructed in military training camps. They were very enthusiastic over the wonders of the radio system and proved adepts at learning the dots and dashes of the Continental code, in which practically all wireless messages are now transmitted and received. Think for a moment of what importance trained women radio operators would be in the event of dire national peril!

It is hopeful that more and more young women will take up the profession each year. There has been an unprecedented demand for radio operators in the past two years, owing largely to the great number enlisted in the American and foreign

Photo, Courtesy of Seven Seas Mag.

Here Are Some of the Patriotic Young Women Studying Radio-telegraphy At One of the Summer Preparedness Camps.

armies and navies. Beside this, there is room right now for women radio experts in many capacities. Owing to the marine laws now in effect calling for two operators on each steamer, and for several other reasons it is self-evident that normally the best chances for women operators will be in land stations

Which brings to mind, among other facts, that of a progressive Boston young lady, who, being a radio operator, found she could not gain a position on a certain ship as two operators were required and one of them was a man! What did she do? Very simple—she married him! Of course this couldn't always happen—far be it from such—but it just shows that—where there's a will there's a way.

When the country-wide call was made recently by the navy department for wireless operators who would be available in time of war the first of sixteen to answer in Duluth, Minn., was Mrs. Otto Redfern, wife of the manager of the Marconi station in that city. Mrs. Redfern is an expert operator and is considering opening a school for women to learn the profession. It seems to be only a matter of time, and a short time at that, before we will have women radio operators as an every day matter of course. We find a fairly good number taking up the studies of wireless telegraphy right now in the principal schools in large cities, particularly New York.

At Boston, Mass., one of the Back Bay society girls who recently attended the "Women's Plattsburg" at Chevy Chase, Md., has just been awarded by the United States Government an amateur wireless operator's license of the first class and is the sixth young woman in the United States to enjoy that distinction.

When she left for the National Service School she took her license along and qualified as a wireless operator in the field.

After studying in a radio school for a short time Miss Baylies appeared at the office of H. C. Gawler, United States radio inspector, in the custom house at Boston, and was put through a two-hour examination. She passed with flying colors. It is said that she obtained a mark of 97 per cent, which has seldom if ever been attained by any male applicant for such a license.

In the test, which was a stiff one, Miss Baylies was compelled to show her knowledge of the Continental Code and afterward drew a diagram and gave an accurate description of an amateur "hook-up." She easily "received" twelve words a minute in the radio code.

Mrs. Alexander MacKenzie, of the New York State Woman's Suffrage party, Yonkers, is the woman who provided material for a very good wireless story several years ago.

Mrs. MacKenzie's son had rigged up a wireless outfit on the roof of her Yonkers home and she learned to send messages and to receive them to a limited extent. During the summer of 1915 she went to the instruments every day at stated hours, morning, noon and night, and flashed out the words—*Votes for women*—400 miles into space. Usually she got replies, sometimes from land wireless stations and sometimes from ships at sea, ranging from "Good for you old lady!" and "We're with you!" to "Oh, piffle!" Then again she assumed to be the Goddess of Liberty, and made quite a wireless "speech" explaining how she had grown old waiting for woman suffrage.

The Yonkers women used wireless in their 24-hour demonstration, election night, last November. They made speeches in Manor House Square and a wireless station above the platform received messages from various celebrities and prominent suffragists. Women radio operators will figure in the adoption of wireless on Hudson River steamers. The Hudson Navigation Company has announced that the *C. W. Morse* and the *Berkshire*, the two largest vessels in the Hudson River passenger trade, have been equipped with Marconi apparatus and that the rest of the company's fleet would be similarly fitted if the new feature proves successful.

Photo Copyright by Paul Thompson

Miss Graynella Packer, the First Woman to Serve as a Commercial Wireless Operator. She Is Seen Operating the Radio Set on the Clyde Liner "Mohawk."

Land stations have already been installed at New York City, Poughkeepsie and Albany. Women operators, dressed in natty blue uniforms, will do the receiving and sending on the steamers.

Wireless telegraphy as a means of livelihood for women and as a means through which they might actively aid their country in time of war is one of the callings in which the members of the Girls' Division of the United States Junior Naval Reserve are receiving instruction. The girls' division of the Naval Reserve was formed to instruct girls in the importance of a navy and a merchant marine for this country in the expectation that a few years hence, when the teachings have had time to permeate among the girls and young women of the country, it will have a tremendous influence on the adoption of a thorough-going preparedness—military and commercial as well as naval—by the federal government.

The preliminary work of organization of the girls' division has been painstakingly done, and two posts have now been formed. One is the Martha Washington Post, of Edgewater, N.J., and the other the Betsy Ross Post, of Bay Ridge, Brooklyn. These two posts form the nucleus of the Girls' Division of Naval Reservists.

The organizers of the movement have refrained from publicity and soliciting enrollments until they were in position to handle the girls who volunteer. They are now in such condition, and the organiza-

(*Continued on page 452*)

Photo Copyright by International Film Service

Another Group of Enthusiastic Feminine Radio Operators Copying Down the Messages as They Arrive. A Preparedness Move in the Right Direction.

How the Farmer Uses Electricity

By H. Winfield Secor

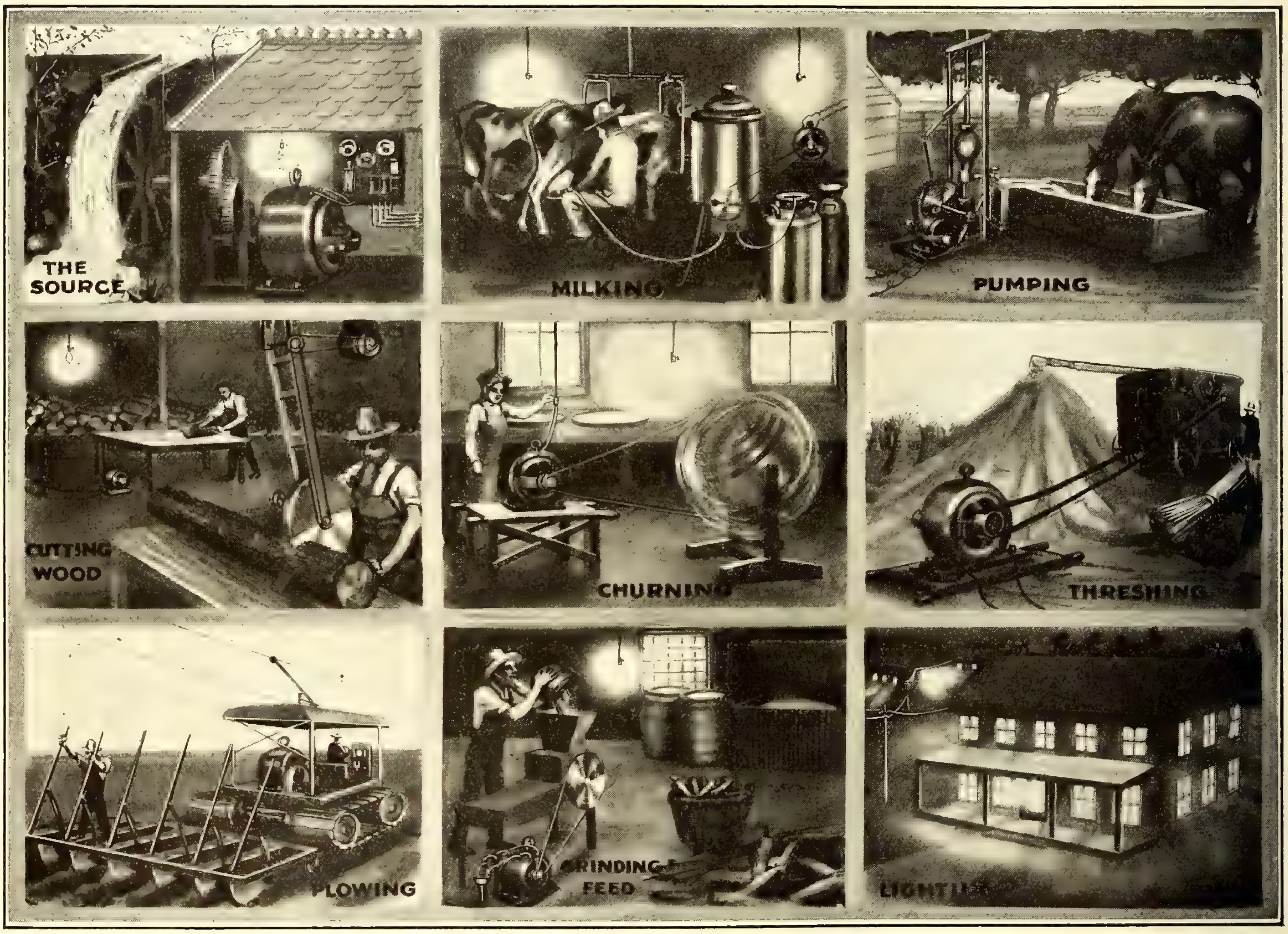
POSSIBLY you were not raised on a farm, and then again perhaps you were. At any rate you and I have, away down in our hearts, always cherished a deadly antipathy for anything that resembled farm work, i.e., real farm work, the kind where you rise with the sun, milk the cows, feed the pigs and horses, saw a cord or so of wood, and then hie yourself with the little brown jug (full of water, to be sure) to the pickle field, there to pick, under a boiling sun, several thousand of Heinz's toothsome delicacies. Or perchance it was a-haying we went, and some *ticklish*, sweat-producing task it was too. And didn't we like to churn the butter with one of those high-speed, vertical, reciprocating types of churns so dear to our forefathers; yes we did *not*, and never will. But some one must cultivate the soil and make the butter or else we couldn't live.

That wonderful genii, *Electricity*, in his myriad moods and phases, has come at last to the farmers' aid. The adoption of electrical devices on eastern American farms has not begun to reach the magnitude of that attained in the western section. It is often the case that the progressive, wide-awake farmer can utilize some natural source of power for the production of his own electric current. A waterfall, for instance, is generally available for driving a turbine or wheel, which in turn may drive a dynamo. The current is easily lead from the dynamo to any point about the farm. A portable electric motor transforms the electric current into mechanical energy suitable for driving a threshing machine or any other mechanism if it is properly rigged up.

An electrically-driven, vacuum milking machine is a necessary adjunct of every up-to-date farm, especially where there are above a dozen cows or so. It will enable one man to milk a number of cows simultaneously, while he could only milk one cow at a time by hand. The modern improved form of vacuum milker is a marvel of simplicity and efficiency. When these new-fangled electrical *milk-suckers* first appeared, the farmer called them down long, loud and lustily. They'd ruin his cows, surer than Satan. They worked too quick and too steadily to suit the farmer, and by-gosh he was right. Most of them landed in the barn-yard scrap-heap. The up-shot of it was that finally the right man came along, studied the cow as well as the milking machine, and proceeded to evolve a modification of the apparatus which would have some mercy on the animal, while realizing a higher efficiency than hand milking.

The machine milker of 1916 vintage is a wonderful contraption. It is successfully used now by the largest milk and butter dairies in the country, where hundreds of cows are milked every day. The secret lies in the fact that instead of creating a steady drain on the cow's udder, or a strain on all the nipples periodically, the milk is now sucked out intermittently, and successively, first from nipple No. 1, then nipple No. 2, and so on, in the order of 1—2—3—4, then 1—2, etc., over again. Moreover, the degree of the vacuum may be accurately adjusted for any animal. Some cows, of course, require a slightly different treatment than others. It is a wonderful sight to see long rows of cows being milked by these machines, the animals standing contentedly and chewing their cud, as if nothing on earth bothered them.

Pumping is one of the hardest jobs on most farms. Some use wind-mills, but the majority of progressive farmers have adopted an electrically driven pump, even though they buy their current from the local electric light company. It is always on the job, while the wind-mill likes to loaf for days at a stretch, sometimes.



Here We See How the Up-to-date and Progressive Farmer Makes Use of Electricity. Electric Motors Soon Pay for Themselves on the Farm in the Time Saved, and the Electric Lights are not a Luxury, but a Positive Necessity, Where Efficiency is the Watchword.

Motor-driven buzz saws are a great boon to the wood chopper. With current distributed all over the farm, it is an easy matter, with a portable motor, to cut up cord wood or logs at any point desired. Besides trees are felled very readily by special apparatus adapted to be driven by electric motors. In one of these schemes the motor drives a fine steel wire at high speed, the wire encircling the tree trunk, and the heat generated in the wood causes

the wire to gradually eat (or char) its way through.

Electric motors fitted in wagons and rated at 5 to 10 horsepower or more are widely used, especially in Europe, for driving threshing and kindred machines. In some instances a farmer owning a threshing machine and portable electric motor manages to make good profits by doing this work for other farmers in his locality, obtaining current for operating the motor either from private service lines on the farm where he does the work, or from commercial or state owned industrial service lines, as is the case in many parts of Germany and England.

In the operations of aereating milk, cream separating and butter churning, the small electric motor comes in as a safe, efficient and readily attached source of motive power. By simply connecting a rheostat or adjustable resistance in series with the motor, its speed can be varied at will. Anyone, from the child of ten years, to the green-horn just over from Poland, can turn on a switch. Electricity is the simplest form of energy to handle, beyond a doubt, and this is one of the principal reasons why it is so attractive to the average farmer. He knows that if he buys a gasoline engine (they all go when you first buy them), that sooner or later he must become a specialist in the various whims and caprices of the carburator, the ignition spark coil and a thousand other devilish, consarned contraptions.

Electrically-operated gang plows have been tried out and have considerable promise. At first thought it may not seem feasible, owing to the vast amount of trolley wires required over a large farm of say several hundred acres. However, it should be borne in mind that modern gang plows often cut a swath up to 20 feet wide. Hence trolley wires 20 feet apart would suffice, and with about a dozen trolley wires on hand one or two such gang plows can be kept going easily; the wires being unhooked at either end of the span and moved to a new position as the plowman progresses. After he has finished the first course, the No. 1 trolley wire is taken down and re-erected after the 12th wire, etc. A switch is best placed on each pole so that the wires can be cut off from the supply feed wire before they are handled.

Around the barn and corn crib the electric motor proves particularly efficacious. It grinds the corn for the chickens, grinds feed for the cows and horses, and performs the dozen and one other things which must be done on the farm, especially about the barns and out-buildings.

Then there is the ever-present problem of artificial light for both house and barn. The oil lantern is rapidly disappearing, owing to the cheapness and other meritorious features of electric lighting. And oil lamps for illuminating the living-rooms —abominable you say. Not only are they a poor source of illumination, i.e., low in candlepower, but they are distinctly dangerous and a constant fire hazard, as insurance statistics prove. To the farmer, the electric light is a blessing in disguise, perhaps, but no less a one than it is to his city cousins. Electric light to him is actually a necessity in many ways, as for instance, where milk is being handled. Lanterns have often been kicked over by a rebellious cow, with a burned down barn as the result. In fact this identical accident is said to have been the cause of the terrible Chicago conflagration of some forty years ago, which created ruin and destruction to the extent of millions of dollars. Properly installed, electric light wiring is no more liable to short-circuit or become defective than other lighting systems. It is certainly far better in this respect than either gas, acetylene, or oil.

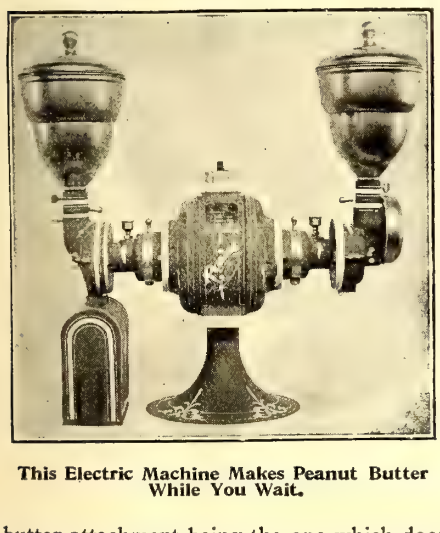
It has been proven that invariably the installation of electric lights pays for itself many times over, no matter whether the current is generated on the premises or purchased from the electric company. There are many reasons why this is so, particularly those involving the effect of light upon certain animals, and especially on chickens, it is said. Besides the farmer cannot help but enjoy his surroundings much better when they are artistically and correctly illuminated. His house is a dozen times more hospitable, and a fine advertisement to burglars and chicken thieves to *keep away!* When he hears a noise, even out in the barn, he can push a button and flood the outlying buildings with light, as also the yard. Three-way switches are often installed, so if Mr. Prowler switches off the lights from his end of the circuit, the owner can simply push another button on the same plate and flash them on again. The thief hates light and the wise suburbanite or farmer is rapidly waking up to this fact.

A number of interesting facts were cited recently by Mr. W. T. Kerr, city electrical engineer of Hereford, England, who urged that greater attention should be given to the use of electricity in farming in England by electric supply authorities, engineers and manufacturers. In Germany and France official recognition had been given to the utility of numerous agricul-

(*Continued on page 452*)

PEANUT BUTTER WHILE YOU WAIT.

The accompanying illustration shows a peanut butter machine combined with a steel cutting, electric coffee mill, the peanut



This Electric Machine Makes Peanut Butter While You Wait.

butter attachment being the one which does not show a receiving can underneath.

The peanut butter machine as a separate outfit is equipped with either 1/3 or 1/2 H.P. motor for direct or alternating current, and is capable of making from 1/2 to 3/4 pounds per minute or 30 to 45 pounds per hour of peanut butter, which meets with a ready sale, because it is more appetizing and nutritious than peanut butter purchased ready packed in jars or tins.

The peanuts are reduced by means of steel buhrs, similar to those used in the pulverizing parts of electric coffee mills, being fed into the buhrs uniformly and at proper speed by an arrangement of rolls contained within the grinder head.

WOMEN TEND DYNAMOS IN ENGLAND.

Owing to the war conditions, girls are used as attendants in the sub-stations of Glasgow, Scotland, where they attend to the 500 K.W. rotary converter units with great success, says *Electrical Engineering*, London. The women are trained first for three weeks at the head office and then sent for a further three weeks to the substation before they are considered sufficiently proficient to take charge. The wages are $5.25 per week while under training, and $6.75 per week on attaining proficiency. They are engaged for a week of fifty-four hours, but the actual average hours per week is only fifty-one. Nine women are up to the present employed at four substations in all, and in addition there are three at the Port-Dundas power station, taking instrument readings, keeping records, and generally doing the work hitherto done by the fourth engineers.

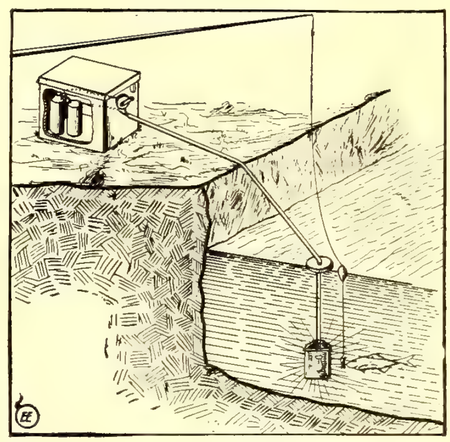
ELECTRIC LIGHT CAUSES FISH TO BITE.

By George C. Denny.

Luring fish by electricity is simply a new and very efficient stunt to which a few batteries and an electric light may be applied. In a recent patent for this purpose an inventor has provided a device which is intended to induce timid fish to venture from their hiding places in drifts, into the open water, where they may be easily caught by the patient and persistent fisherman.

The device consists merely of an electric lamp incased in a strong glass container, a float to regulate the depth of the glass, a coil of wire, and a few batteries to energize the lamp. The wires are insulated from the water by a length of rubber tubing and the batteries stored in a portable box on shore. The flexibility of the tubing, however, does not permit it to bend under the stress of flowing water. A small switch mounted on the outside of the box completes or opens the circuit to the lamp at will.

When the fisherman is ready for operations he sets his float at the proper place and drops the lamp into the water. He then allows his line to hang alongside the lamp and proceeds to make himself comfortable. The fish soon crowd around to view the electrical display and when one attempts to relieve the hook of its bait, the angler pulls him in. After all of the fish at one place have been drawn from their hiding places, the fisherman turns off his light and draws it shoreward. The tubing is now coiled and placed with the lamp and float in the box containing the batteries and, picking up



Now We Have an Electric Lure for Fish in the Form of a Small Electric Lamp Placed Close to the Hook.

his box and fishing tackle, the merry angler proceeds to invade another choice spot where the fish have as yet not been introduced to the wonders of electricity.

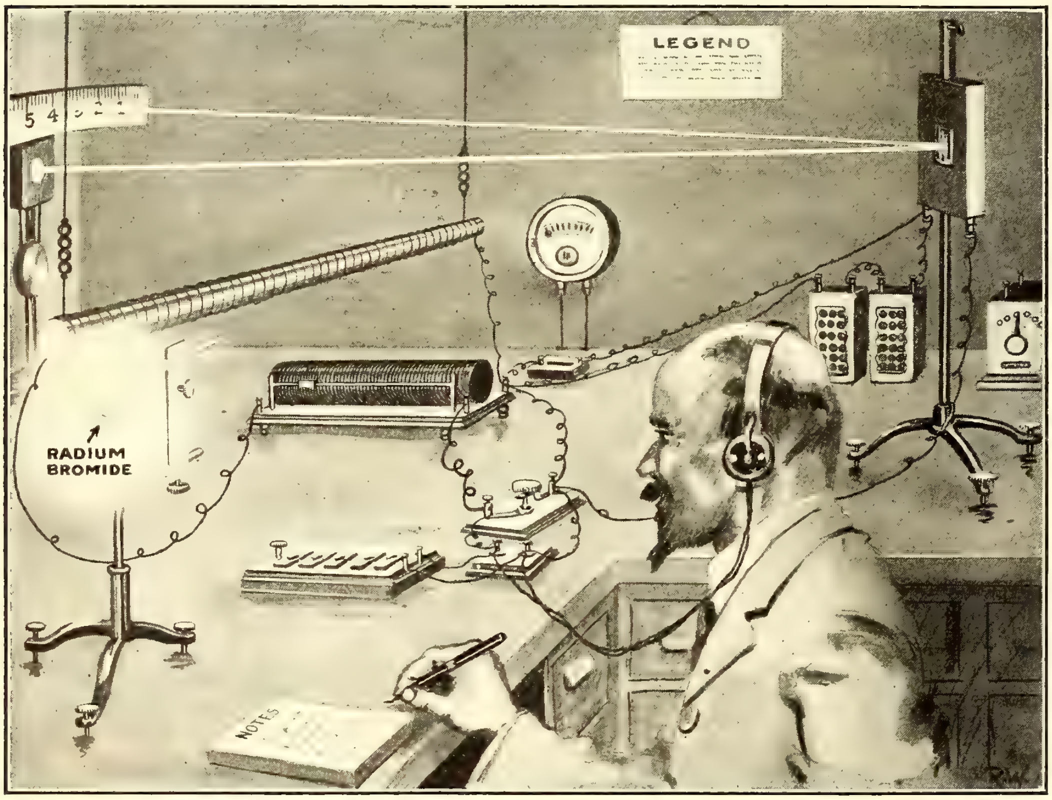
Intensifying Radio Signals with Radium

SOME most interesting facts regarding the effects of Radium on wireless telegraph receiving apparatus have been given recently by E. Bemier, a German scientist.

On the results of Szilard with radium-coated lightning conductors becoming known to the author he was led to consider the possibility that radium might exert some effect upon the reception of radio-telegraphic signals. The first tentative experiments seemed to give evidence of positive effects; but as the author was obliged to discontinue them in consequence of the world war he now publishes his results with a view to stimulating further research and also obtaining independent confirmation of his own conclusions.

The first experiments were made with an indoor antenna consisting of a wood rod loosely wound throughout its length with wire, the rod being directed towards a sending station, FL, about 300 kilometers distant from it. This antenna was suspended in a room as the illustration shows. The receiving set used comprised a galena detector, 4000 ohm telephones, and a tuning coil having 800 turns of enameled wire. No signals were audible from FL at any position on the tuning coil. Signals were, however, at once distinctly audible as soon as a sealed glass tube containing radium bromide of 50,000 units (and thus very weak) was brought near. The signals vanished when the shunt resistance was 220 ohms, using the shunted telephone method. The tuning was not at all sharp, and showed no maximum for any length of included wire between 80 and 120 meters. A change in the position of the radium did not produce any noticeable differences; but the orientation has a marked effect. At certain wide angles the reception ceased entirely.

Mr. Bemier, encouraged by these results, continued his investigations in order to determine the effect of radium on an ordinary antenna. The antenna consisted of two parallel 1.5 mm. phosphor-bronze wires held 1 meter apart and 8 meters above the ground, directed towards the station FL, as was also the connection to the receiving set. For this latter the same tuning coil was employed; but an electrolytic replaced the galena detector, and in place of the telephones a special moving-coil, reflecting mirror galvanometer, of 500 ohms resistance and period two seconds, was used. The signals utilized were the 10-second time signals from FL. With the best tuning and 56 meters the telephones gave 80 ohms for silence; the galvanometer showed 20-21 microamperes (one microampere is the one millionth part of an ampere). With the antenna disconnected the current through the detector was 0.7 microampere.



A German Investigator Has Discovered That if a Tube Containing Radium Bromide Is Brought Near a Wireless Aerial, the Strength of Signals Will Be Intensified. A Coil Antenna Was Used as Shown.

On the radium tube being brought near to the free end of the antenna the galvanometer reading was 50-53 microamperes; to reach this maximum the tuner had to be shifted from 56 to 48 meters. In this position the reception without radium was quite as mistuned as it was in the 56 meter position with radium. When the radium was fastened at the mid-point of the antenna no reception was possible, even with the telephones. With the radium arranged at the connected end of the antenna the current through the detector increased to 35-38 microamperes at the 40-meter tuner position. All the results have been definitely confirmed as a result of numerous control experiments, made under conditions as nearly similar as possible.

These experiments show that by suitably bringing up radium in proximity to the antenna the vibration image of the latter is changed in the direction of an apparent shortening of the wave; further, that a considerable increase in signal strength, as measured in the detector circuit, is occasioned by the proximity of radium, which must in any case be caused by a higher received primary current.

The proximity of radium to the tuning coil itself has, however, the effect of rendering distinctly worse the previously distinct telephonic reception, without it being possible to discern any definite mistuning, and this applies whether the radium tube be insulated or earthed. On the other hand, the radium tube exerted no noticeable effect on any of the other parts of the receiving equipment.

HUMIDITY AND THE STATIC MACHINE.

It is often said that static machines cannot be used successfully in humid weather. This is the experience of those only who do not understand the care of the static machine, for there is no climate on earth where a static machine cannot be used with more or less efficiency if proper care is taken to keep the interior of the tightly closed case dry, says the Editor of the *Journal of Electro-therapeutics and Radiology*. A static machine that is used in a humid climate, however, should be renovated once every year if it receives the usual use of the busy man who recognizes its value; for the nitrous oxides produced within the case are certain to deteriorate some of the metal parts, which if they are re-lacquered and the glass revolving plates reshellacked, renders the machine in excellent condition against humidity, providing a proper drying material is kept within the case.

Some employ sulphuric acid in a large receptacle, but most observers have found the commercial calcium oxide in hard chunks the most effective means for absorbing the moisture. One mistake made by those who do not perceive the danger of lowering the efficiency through permitting dust to fly into the machine is that the container is not well covered. To place several bags, with one thickness of muslin over them, in a box is not adequate protection against letting the dust out. If this is done and an additional wrapping of good muslin fastened about the whole box and tacked tight in such a manner that the dust cannot escape, it will be well. Otherwise place the lime in a box with slatted sides, which will contain when two-thirds full, forty to sixty pounds of dry lime according to the size of the machine, and cover it over with two thicknesses of the best, finely woven, unbleached muslin tacked in around the edges so that no dust can escape, and it will be all that is required in any climate if changed from once a month to once in two months, to keep the interior of the case in proper condition.

Direct public wireless service connecting Japan with other countries, has been inaugurated between Ochiishi, on the east coast of the Kokkaido, and Petropavlovsk, in Kamchatka, Siberia.

A chain of wireless stations is being erected around the entire coast of Australia so that vessels are never out of communication with shore. These stations also connect with similar stations at New Zealand and Fiji. Soon all the English possessions in the South Sea will be connected by radio.

GEORGE WESTINGHOUSE.
October Marks His 70th Birth Anniversary.

Born, Oct. 6, 1846. Died, March 12, 1914.

George Westinghouse, the world famous inventor of the air brake, died of heart disease at his home in New York City, March 12th, 1914, aged 67 years. Mr. Westinghouse as well as being one of the world's best known inventors was also an electrical and mechanical engineer of the highest standing.

Mr. Westinghouse was born at Central Bridge, Schoharie County, New York, October 6th, 1846. His paternal ancestors came from Germany and settled in Massachusetts and Vermont before the Revolution; his maternal ancestors were Dutch-English. His father was an inventor, who in 1856 removed his family to Schenectady, N.Y., where he established the Schenectady Agricultural Works. Here George attended the public and high schools of the town, spending much of his leisure time after studies in his father's machine shop. Before he was fifteen he had invented and built a rotary engine.

In 1865 Mr. Westinghouse invented a device for replacing railroad cars upon the track which was manufactured for him at Troy, N.Y. He then made attempts to devise an automatic brake for railroad trains, but this was unsuccessful because steam was employed. He then hit upon the use of compressed air and the brake was designed which afterwards completely revolutionized railroad operation the world over. Drawings of an air pump brake cylinder and valves were made, but considerable time elapsed before a practical trial was undertaken. The first patent was issued April 13, 1869. The Westinghouse Air Brake Co., was then formed on July twentieth of the same year and a small factory was built in Pittsburgh in 1870.

In 1886 the Westinghouse Electric Co., was formed for the manufacture of lamps and electric lighting apparatus, Mr. Westinghouse having turned his attention in that direction. The business rapidly developed and in 1889 and 1890 this company absorbed the United States Electric Co., and the Consolidated Electric Light Co. In 1871 all these properties were re-

George Westinghouse, Famous American Engineer and Electrician, Whose Name Is a Household Word Throughout the World. At His Death He Headed a $200,000,000 Electrical Manufacturing Corporation.

organized into the Westinghouse Electric Mfg. Co.

The question of the steam turbine and its application was investigated by Westinghouse and he secured for his company the patent rights of Charles A. Parsons, the famous English engineer, on the turbine in 1897-8. His study of the new prime-mover soon led the inventor to consider its use for ships. He accomplished this work in collaboration with the late Admiral George W. Melville and John H. MacAlpine Wilkin. In the latter years of his career he also occupied himself with the development of air cushioning devices for automobiles and motor trucks. which rapidly came into favor.

He was one of the first to perceive the limits of the direct current system and in 1885 acquired the American rights of Messrs. Gaulard and Gibbs in connection with alternating current distribution. He then gathered about him such shining lights as William Stanley, Nikola Tesla, O. B. Shallenberger and others who contributed not a little to this development. He backed Mr. Tesla with both manufacturing and financial assistance in the development of the induction motor while his foresight in perceiving the advantages of the alternating current transformer for varying pressures has made possible the transmission of energy over vast distances and its utilization at remote points.

Mr. Westinghouse was given the honorary degree of Doctor of Philosophy by Union College in 1890. He was also decorated with the Legion d'Honeur of France, the Royal Crown of Italy, the Grand Cross of Leopold of Belgium and others.

At the time of his death Mr. Westinghouse was president or director of twenty-two companies with works in all parts of the world, there being between thirty-five and forty Westinghouse companies in Europe and America. He employed 50,000 persons and the capital of his company was $200,000,000. The name Westinghouse may be seen on electrical machinery in every quarter of the civilized globe—from the southernmost parts of Africa to the frozen climes of Alaska.

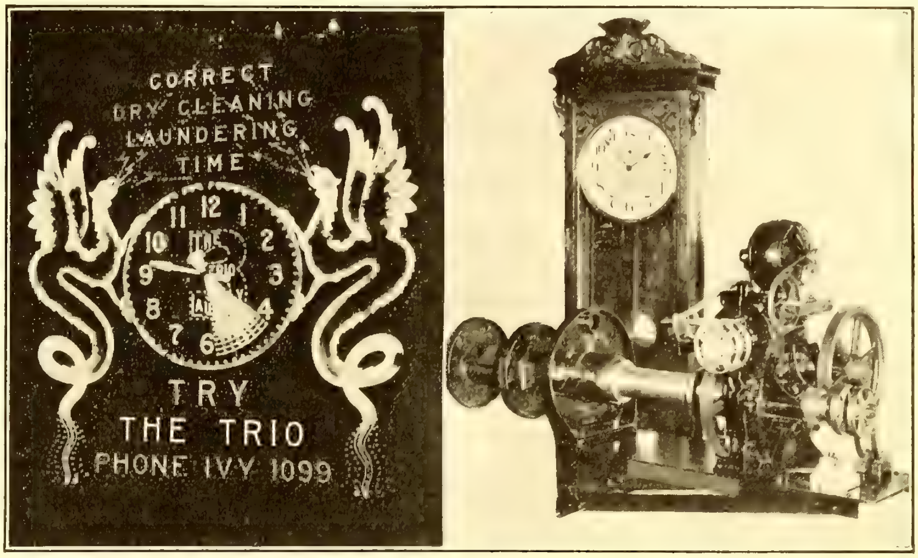
A Mammoth Electric Clock

The accompanying photograph shows a mammoth electric clock recently installed at Atlanta, Ga. The action of the sign is well chosen and attracts a good deal of attention. The flasher starts with the lighting of the ring around the dial of the clock. Next the dragons appear with shimmering wings and tail, spitting flashes of lightning which pass through the lettering on the top. The color of the lightning is amber, while the dragons are outlined with green lights. The following words are flashed in consecutive order:

Correct Laundering
Correct Dry Cleaning
Correct Time.

All these are illuminated with opal lamps.

The figure "3" in red in the center of the clock, also the words "The Trio Laundry" are illuminated and remain constantly lighted. This magnificent and striking sign measures 45 feet high by 33 feet wide and weighs 17 tons. A special steel frame structure was built for it, as it covers the roofs of two buildings. The total number of lamps used on it is 2,000 of the five-watt size.



Novel Electric Clock and Its Master Clock, Also Lamp Controller as Installed at Atlanta, Ga.

The special flasher used in operating this sign is illustrated at the right. The master clock is used for timing the large sign clock. This is done by having contacts on the main clock which operate the motor; the latter, in turn, revolves the clock hands by means of a set of gears as the reader will perceive. The construction of flashers has become an engineering feat in itself as one can see by the manner in which this one was made. *Photo courtesy Betts & Betts.*

WITH THE NOVEMBER ISSUE

we will present a new

SUPPLEMENT

of a famous electrical inventor. This is the first of a series promised to our readers.

These supplements are printed on fine art paper, ready for framing. They are invaluable to adorn your den, your wireless station, or your laboratory.

Order your copy now, to make sure you will get it.

ILLUMINATION OF BALBOA COALING PLANT.

Plans are being made for illumination of the mighty cranes at the Balboa coaling plant at the Pacific end of the Panama Canal to the end that they may be worked at night as freely as by day.

WATCH THIS "ELECTRIC SIGN" HUNTER HIT THE BULL'S-EYE.

The electric signs along the Great White Way of New York City are becoming daily more attractive and ingenious it seems. This photo illustrates one of the latest electric signs erected recently at Broadway and Forty-ninth Street. This measures 71 feet 8 inches long by 41 feet 5 inches high and contains 3,500 incandescent lamps.

Every Time This Electric Sign Huntsman Fires His Gun He Is Sure to Hit the Bull's-eye. A Recent New York City Product in Progressive Advertising.

At first a series of words are flashed out; the length of each letter of the various words is different; the largest 8½ feet tall and the smallest 4 feet. When the phrases are distinguished, two men appear, standing in the grass, each leaf of which is caused to wave very realistically by a special flasher operating a certain group of lamps. At the beginning the man at the left holds a gun at his side and in a few seconds he raises the gun to his shoulder and shoots.

The discharge of the bullet and the accompanying effect are apparent from the photograph. As soon as this action is finished, the sign is automatically extinguished and the words "A Sure Hit, Etc.," again appear. This interesting electrical display was built by the *O. J. Gude* concern.

GRAVITATION AND TEMPERATURE.

As the outcome of a very delicate systematic series of experiments it is announced by Dr. P. E. Shaw that "when one large mass attracts a small one the gravitative force between them increases by about 1/500 as temperature of the large mass rises from, say, 15° C. to 215° C."; that is, it increases by about 1.2×10^{-5} of itself per degree Centigrade. This seems to be a very startling result; at any rate if temperature is merely the expression of internal molecular motions, as, indeed, Dr. Shaw seems to admit, says a writer in *Nature*.

By Newton's principle, gravitation between masses must act reciprocally; the result, therefore, means that the astronomical mass of a body must increase with temperature by 1.2×10^{-5} of itself per degree Centigrade. The pendulum experiments of Bessel and recent determinations by Eötvös seem to establish proportionality between gravitational mass and mass of inertia, irrespective of temperature, well beyond these limits. Thus inertia also would have to increase with temperature; and when a freely moving mass is becoming warmer its velocity must be diminishing, for its momentum must be conserved. A comet like Halley's is heated upon approach to the sun; thus it should suffer retardation in the approaching, and acceleration in the receding part of the orbit, enough probably to upset existing astronomical verifications. Indeed, as regards change of inertia, we can recall the principle applied by Professor Joly to the question whether chemical change involves change of mass, viz., that every mass around us is moving through space with the velocity of the solar system, and a sudden rise of temperature in a body must therefore involve a violent kick if its inertia is thereby sensibly altered.

Electrodynamic theory does establish unequivocally an increase of inertia of a body arising from gain (δE) of thermal or electric energy; but this is only of amount $\delta E/c^2$, where c is the velocity of radiation, and so is minute beyond detection. The question whether there is also an equivalent increase in gravitational mass evades discussion until some link connecting gravitative and electric forces has been established.

U.S.S. "TENNESSEE" TO BE PROPELLED BY ELECTRICITY.

The contract for furnishing the necessary equipment for the electric propulsion of the U.S.S. *Tennessee*, the superdreadnaught of the largest and finest class, now under construction, has been awarded to the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa.

The system of propulsion being installed differs from any now in use by battleships. Instead of the propellers being mechanically connected to the driving engines or turbines, there are two steam turbines developing over 33,000 horse-power driving electric generators which furnish current to four 6,700 horse-power motors, each motor driving a propeller.

Electric drive for battleships has been adopted after a careful investigation by the Navy Department to whom it presented numerous features of structural, operating, and military advantage, among which are: that the steam turbines developing the electric energy may be located in any desired portion of the ship, that the propelling machinery may thus be better protected from injury, that full power may be available for reversing, and that greater rapidity in maneuvering is made possible, compared with existing mechanical systems of control.

In addition to the main generating equipment and propelling motors, the contract includes the auxiliaries for the main turbine generator sets and smaller auxiliary turbine generators supplying light and power throughout the ship. The *Tennessee* will have several hundred electric motors for doing nearly all the work on board from raising the anchor to steering. Electricity will also be used for cooking, ice making, refrigeration and numerous other purposes. In all about 27,500 horse-power of electricity will be needed, the amount required for a city of about 100,000 inhabitants.

OSTEOPATHS FAVOR ELECTRICITY.

One of the most significant features of the twentieth annual convention of the American Osteopathic Association in Kansas City recently, was the large number of exhibits of electrical devices, and the extensive interest of the two thousand members in the application of electricity to the practice. Osteopaths generally are installing high frequency machines, and more and more they are adding X-ray machines, and diagnostic and therapeutic instruments.

UNIQUE UNIVERSAL MOTOR UNIT FOR KITCHENS.

The universal motor unit shown is so constructed that it will drive all kitchen appliances without any reconstruction whatsoever. The driving arm may be raised or lowered to suit any height of appliance. There is a horizontal as well as a vertical drive. The drive shafts are equipped with a chuck and crank. The chuck is used when the handle of the appliance can be easily taken off, while the crank is used when the handle of the appliance cannot be removed. The shelf is for supporting the appliances which have table clamps. There are holding hooks provided to hold appliances in position while being driven. The motor is one-sixth horse-power and is furnished to suit all commercial service specifications as to voltage and frequency.

Here Is an Electric "Maid-of-all-work" for the Kitchen. It Includes an Electric Motor and Various Attachments for Performing Multifarious Operations.

The Unit, as it is called, is finished in dark maroon with the shafts either nickel plated or polished steel.

BATTERY-DRIVEN FIRE APPARATUS.

One of the most interesting applications of the electric truck is to the service of fire departments. Considerable time was devoted to the discussion of this subject at the recent National Electric Light Association convention in Chicago. It was pointed out that equipment of this kind is now in successful use in New York, Philadelphia, Camden, New Jersey; Springfield, Massachusetts; Akron, Ohio, and Hartford, Connecticut, and in Berlin, Hamburg and other European cities.

The experience of the Philadelphia Fire Department is an interesting case in point. Nine pieces of electrically operated fire apparatus are in operation in the city and in two of the fire houses there have been quartered at the same time gasoline, electric and horse-drawn vehicles. On average runs up to a mile and a half the electrics have invariably been the first to the fire, the highest recommendation a piece of fire apparatus could ever have.

HOW WE USE COPPER WIRE.

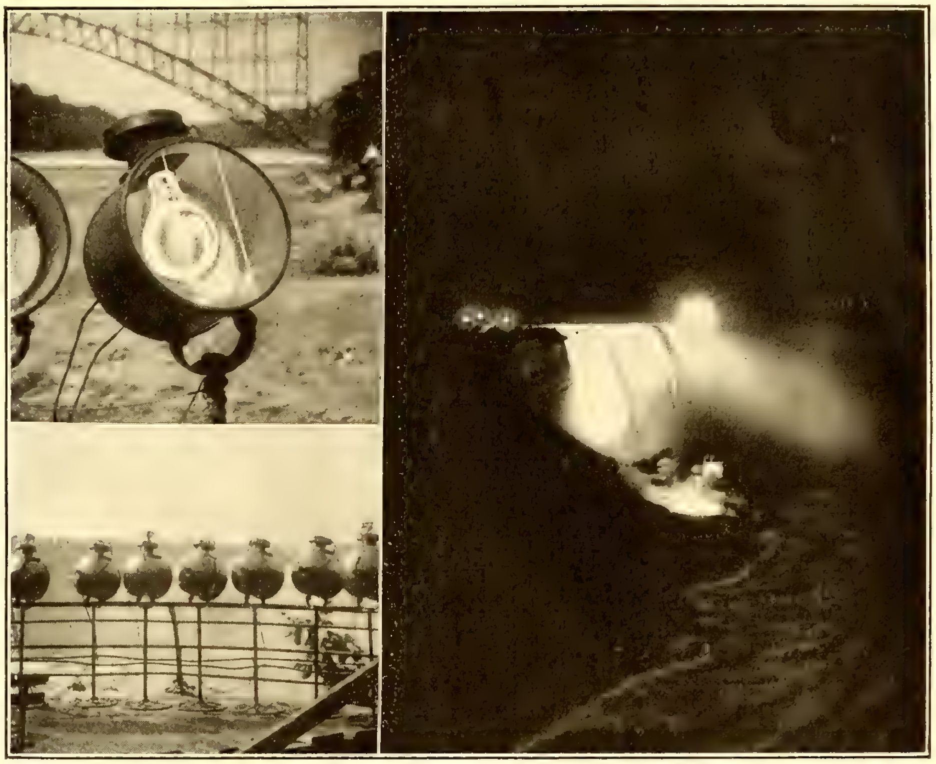
The total quantity of copper wire drawn in 1914, according to the preliminary statement of the Bureau of Census, Washington, D.C., whether for consumption or for sale, was 131,484 tons, as compared with 147,156 tons in 1909, the decrease being 10.6 per cent.

Copper products taken as a group decreased 16.5 per cent in value during the five-year period. In 1909 the weight of all copper wire and wire products, including the copper wire used in the manufacture of insulated wire by the producing companies, but excluding the weight of the insulation, was reported as 154,231 tons. In 1914, when the aggregate weight reported for insulated wire included the weight of the insulation, the aggregate weight of bare wire, insulated wire, and fabricated copper-wire products was 135,437 tons, with a value of $42,928,550.

Bringing Niagara Falls Out of the Night by Incandescent Lights

By Raymond Francis Yates

It has long been considered that the electric arc is the most powerful source of light known, but is far from being the most economical, owing to the terrific heat generated by it. It is acknowledged, however, by all prominent men in the electrical field that incandescent illumination will soon reach that degree of perfection which will make it advisable to entirely abolish the use of the electric arc as a source of light, owing to its undesirable heat and consequent waste of energy.



Several Views of Recent Flood-lighting of Niagara Falls. At Left—Group of 1000 Watt, Incandescent Tungsten Lamps Used, also a Single Unit. There Will be 130 Such Lamps Used to Illuminate the Falls.

A distinct and notable advancement in incandescent illumination was recently made when it was decided to light the great waterfall of Niagara by this means. Five years ago, without the aid of the nitrogen-filled lamp, this would have been considered an impossibility, but today, thanks to the efforts of those workers who have labored in this new field, it is not only absolutely practical but far more economical and artistic than any other means.

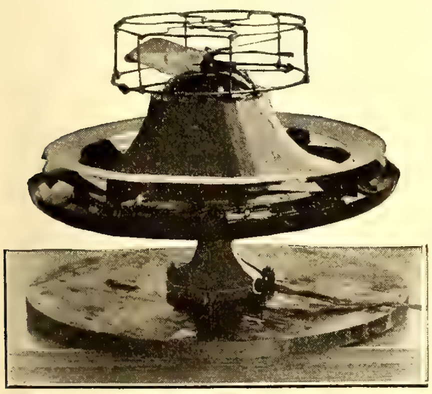
The lighting of Niagara Falls at night was attempted by a Chicago concern, who manufacture a patented reflector or hood of special design, which, by the corelation of its parts, casts a beam of light that greatly resembles that of sunlight, and instead of being concentrated into a thin ray it spreads out and diffuses throughout the mist of the Falls in a perfectly natural manner. The mist seems to actually scintillate and sparkle under the influence of the light and it is indeed wonderful to think that Niagara is really bathed in the radiance of its own might.

The lamps used in the reflectors are especially designed for this purpose and consume about one kilowatt of electricity, or approximately one and one-third horsepower. It has been decided that one hundred and thirty lights will be necessary to properly illuminate the Falls as well as the rapids. This will consume about one hundred and seventy horsepower. At present twenty-five of these powerful flood lights are focused on the waterfall nightly.

A NOVEL VERTICAL ELECTRIC FAN.

By Frank C. Perkins.

The accompanying drawing and illustration shows the design and construction of



An Innovation in Electric Fan that Moistens Air by Blowing it Over Water Placed in a Trough Beneath the Blade.

a unique, vertical electric ventilating fan, developed at Kansas City, Kansas. It is claimed that this electric device provides a thorough circulation of air in all parts of a room without requiring the fan to be oscillated or revolved in the usual manner and it further provides a novel means for moistening the air in a room. An extremely unique deflector mechanism is adapted to be attached when desired.

In the operation of this device, when the shaft is rotated so as to force the air downwardly, the air so forced will strike the deflector and will be directed thereby outwardly in all directions. Part of this will pass down toward the floor, after passing over the water receptacle. Some of the air will pass horizontally outwardly, being so guided by and between the plate and the water in the receptacle that some of the air will be deflected upwardly by the deflecting plate.

It is pointed out that by means of this construction just described, the air will be kept in constant circulation in all parts of the room. This will be effected without any unequal distribution of the air, such as cause drafts when the circulation is produced by fans which can only force the air in one general direction, or which must be oscillated or revolved in order to force air in different directions.

It is claimed that this vertical electric fan effects better circulation of the air, and without requiring any part of the current which operates it to be wasted for oscillating or revolving functions than can be obtained with the usual stationary oscillating or revolving fans.

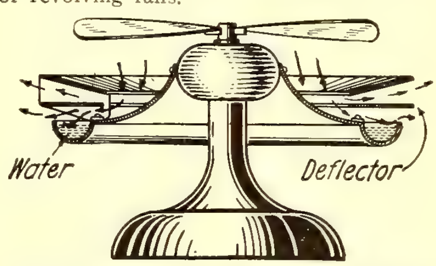
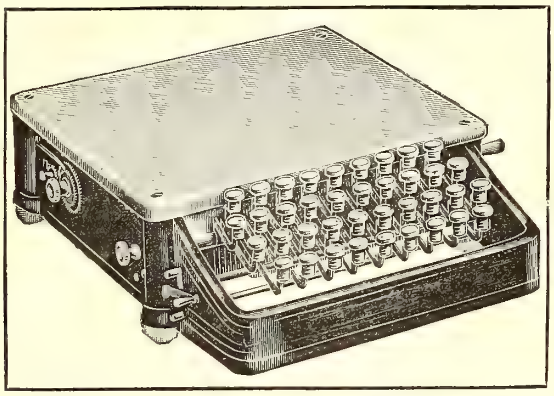


Diagram Showing How New Electric Fan Cools Air.

Electric flashlights of the pocket type are being extensively used by soldiers of all the warring nations. Important signals are often transmitted by flashing the lamp a prearranged number of times.

Automatic Keyboard Transmitter for Wireless and Telegraphy

Of the seventy automatic transmitters patented in the last twenty years, only one has stood the tests under actual operating conditions. There are already a number of



An Automatic Telegraph Code Transmitter That Prevents "Telegrapher's Cramp." Works on Any Line. Push the "Letter" Key; the Machine Sends Out the Proper Dots and Dashes.

automatic transmitters now used in connection with the high speed, mechanical reception, but there is only one, so far, which can be used by any one on any kind of a telegraph line. No matter if an operator has lost the control of his wrist, or if he is absolutely unfamiliar with the telegraph code, he can send out smooth, steady characters which cannot be equalled by manual operation.

There are a number of important and unique mechanical features about the present transmitter which have overcome all the difficulties encountered in other types. The first point about the instrument is that no tape is employed, that is, the characters are sent out directly by the pressure of the keys. The keyboard is arranged according to the typewriter standards. When the transmitter is to be used, the spring motor is wound by means of a handle at the right hand side. Then the switch at the left is pressed upward. This releases the keys, opens the line, and starts the motor. To transmit, the keys are pressed with an easy, staccato touch. It is impossible to press two keys at the same time, so that the letters cannot be run together. In sending, the operator quickly learns to work at the speed at which the control is set. A variation of the speed, ranging from ten words to fifty, is obtained by means of the adjusting screw at the left hand side of the case.

While the operator is pressing the keys, a number of ingenious arrangements in the case are performing the usual manual operations. The transmitter is thirteen inches long, eleven wide and four high. The case houses two distinct mechanisms, the motor and the actual transmitting apparatus.

The motor has four separate springs, each containing seven feet of spring, one inch wide. At the left is the speed governor and reducing gears. The mechanism, which makes the dots and dashes, is in a removable unit. Through the center of the unit is a fluted shaft which is turned continually by the motor. Around the shaft are copper character rings, the circumferences of which are broken up by insulated spaces, to form dots and dashes. These rings do not turn ordinarily, however, as the fluted holes through them are larger than the diameter of the shaft. Along the front of the unit is a row of trips, one for each ring. When a key is pressed, a trip is released. This drops the ring so that it engages with the fluted shaft and is revolved. At the back of the unit is a row of contacts for the rings. Ordinarily the contacts rest on insulated parts of the rings, but as a single ring revolves, the circuit is made or broken as the ring turns beneath the contact. On most of the rings are two letters, that is, on the "B" ring, a complete revolution makes —... twice, but rings for the short letters, such as "E" make six dots to a revolution. When a ring revolves far enough to send one letter, a pin on the circumference engages the trip, and restores it to its former position. This also raises the ring from the shaft.

These automatic transmitters are for either Morse or Continental codes. To change from one code to the other, it is only necessary to change the transmitting unit. This requires but a moment's work. For telegraphy, the machine is connected to the line by inserting a spring contact in the key, as other special keys are connected. In wireless work, however, it is necessary to use a pony relay, for the current is too great for the small contacts on the character rings. This transmitter, connected with a buzzer sends out the smoothest signals imaginable.

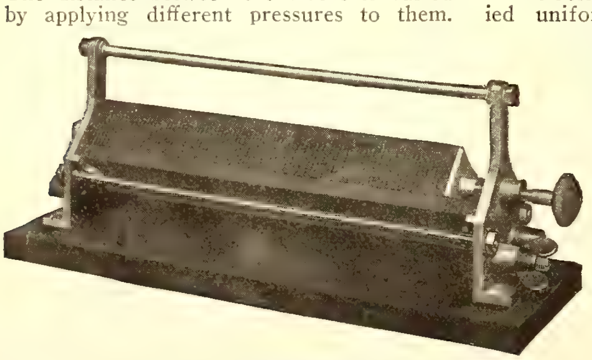
A NEW COMPRESSION CARBON RHEOSTAT.

The illustration herewith shows a new form of compression type carbon rheostat for making fine measurements. A number of carbon blocks are placed in a rack. The distance between the blocks is varied by applying different pressures to them. The pressure adjustment is changed by means of a powerful hand screw compressing the end plate.

This form of rheostat is recommended particularly for use in calibrating electrical instruments, battery testing and photometric work.

The resistance of this device can be varied uniformly by simply changing the amount of pressure exerted on the carbon plates by rotating the tension adjusting screw. The number of blocks in the circuit may be reduced by means of an extra terminal supplied with the rheostat, which may be inserted between any two adjacent plates.

This resistor is made in two sizes of 200 Watts and 1,000 Watts capacity respectively. The smaller unit has a resistance of 10 to 8 Ohms and the larger a resistance of .05 to 2 Ohms. The momentary over-load capacities are 500 and 2,000 Watts respectively.

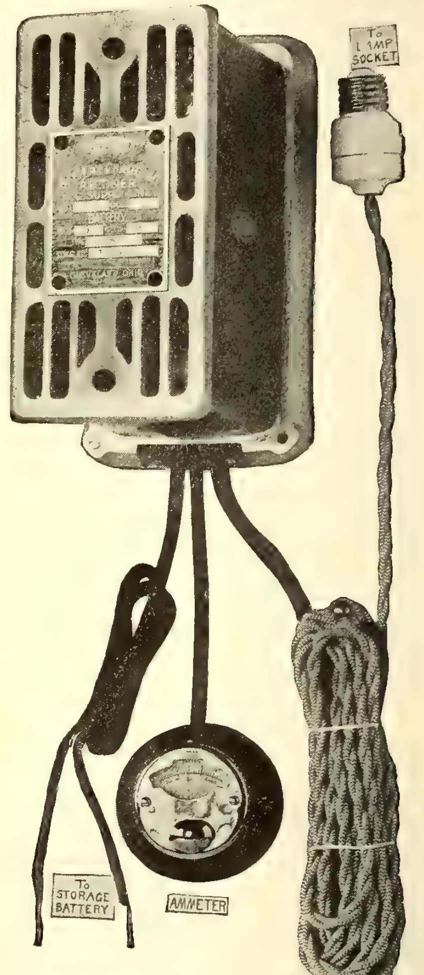


Useful Rheostat in Which Carbon Blocks May Be More or Less Compressed by a Hand Wheel. Excellent for All Laboratory Work.

NEW A.C. TO D.C. STORAGE BATTERY RECTIFIER.

The illustration herewith depicts a new A.C. to D.C. rectifier suitable for charging ignition storage batteries, etc. In operating this device it is merely necessary to screw the plug secured to the end of the lamp cord into any nearby electric light socket and the current is then turned on. The positive and negative wires from the rectifier are then attached to the proper terminal posts on the battery, when the ammeter connected with the outfit will indicate the charging rate. This outfit is particularly efficacious in recharging 6 volt ignition and lighting batteries for automobiles. They can be revitalized over night with this device at a current cost of from 3 to 10 cents, depending upon the capacity and state of charge in the battery.

The equipment here illustrated will undoubtedly find a wide field of usefulness



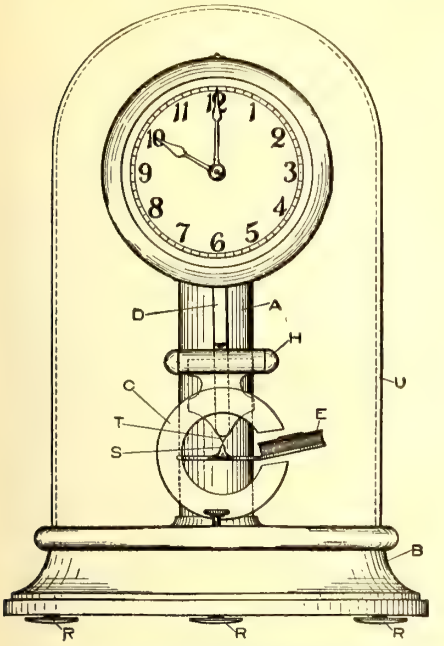
Very Complete Storage Battery Rectifier for Auto Owners and Others. For Use in Changing A. C. Into D. C. Utilizes Both Halves of the A. C. Wave.

among automobile owners and others having use for such an apparatus. It is provided with non-sticking electrodes and both halves of the A.C. waves are utilized, thus realizing the maximum efficiency for this class of instrument. They are furnished in several sizes, suitable for recharging 6, 12, 16, 18 and 24-volt storage batteries or two, three or four 6-volt storage batteries at one time. They are usually operated on 110 volt 60 cycle A.C. circuits, but can be supplied for other voltages and frequencies when desired.

The Dutch government proposes to establish wireless communication between Holland and the East Indies by way of San Francisco, Honolulu and New Guinea.

MAGNETIC CLOCK WILL RUN TWO YEARS.

THERE has recently been perfected and placed upon the market a new kind of timekeeper known as the Warren Magnetic Clock, which the manu-



Front View of the New Magnetic Clock, Said to be One of the Simplest Ever Designed and Extremely Accurate.

facturer claims embodies improvements in the mechanism, and especially the escapement, more radical than any made during the previous century.

From the base of the clock (B) there arises a column (A) which forms a support for the pendulum and the movement, and also contains the battery. The pendulum consists of a permanent magnet (C) riveted firmly to a rod (D) of "Invar," which is a metal practically unaffected by changes in temperature.

Mounted upon the column (A) and located within the gap or opening of the magnet (C) is a coil of extremely fine insulated wire (E), and the ends of this fine copper wire are firmly soldered to two brass rods at the back of the column.

Within the column (A) there is room for a special battery cell of the same diameter but somewhat longer than the cells that are commonly used in flashlights. This battery cell rests upon a strong spring and is held down by the pointed end of a brass rod which may be swung away from the battery in order to replace it.

Mounted upon the pendulum rod is a brass case (H) within which is located an electric pulsator consisting of a sealed glass tube from which air has been carefully exhausted. Inside this glass tube is an inner steel tube, protected from all atmospheric influences such as dust, moisture, or oxidation, containing (presumably) mercury, which sends electric impulses through the coil (E) at every complete swing of the pendulum. These impulses are of such a nature as to maintain the swing of the pendulum in practically the same width of arc whether the battery be new or old. If the swing of the pendulum be increased or decreased by external means, the electric pulsator (H) will quickly restore it to its normal arc.

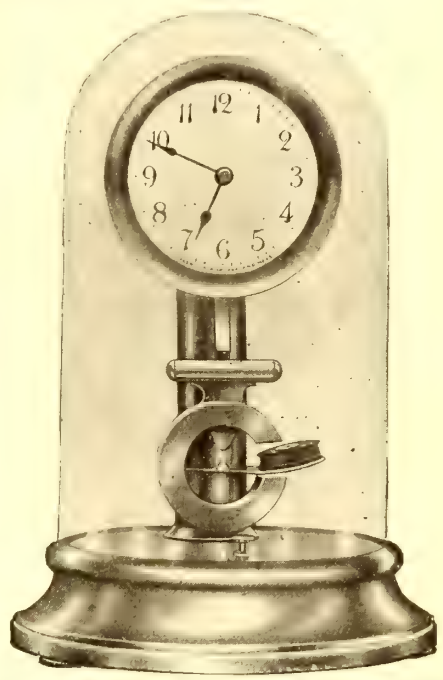
With this clock, owing to the efficiency of the electric system, the battery will last two years in service. The amount of current consumed by the clock is so small that an ordinary dry cell such as is used in ringing bells will easily run twenty-five clocks simultaneously for several months.

Motion is transmitted from the pendulum to the movement as follows: A case which is practically airtight is screwed to the back of a heavy brass plate carrying the movement. Within the case, mounted in sapphire jewels so as to revolve with the utmost freedom, is a vertical pivot made of hardened magnet steel. Upon this pivot is cut a coarse screw thread. Meshing with this screw thread but not clearly shown is a gear mounted upon a horizontal pivot. The lower end of the needle carries a curved extension projecting downward into a cup or depression at the bottom of the case. This cup is nearly filled with a fine quality of light mineral oil. Neither air nor dust can enter the case and the oil which it contains cannot possibly escape. Mounted upon the pendulum rod (D) is a little platform or bracket just below the clock dial, and concealed upon the platform are two very small permanent horseshoe magnets. The poles of the magnets strongly attract the curved extension at the lower end of the needle inside the case, through two thicknesses of metal and an air-space.

According to a new principle broadly patented the reciprocating or swinging motion of the pendulum which moves the pendulum (D) and bracket to and fro across the axis of the magnetic needle causes the latter to revolve once for every complete swing of the pendulum.

The oscillating motion of the pendulum is thus converted into a continuous motion of rotation of this needle and thus by means of a screw thread transmits motion, at a greatly reduced rate, to the first gear of the clock train. The remainder of the clock train is more or less conventional although the bearings are so designed as to run without lubrication. The entire works of the clock are protected by a dust-tight cover.

The advantages of this method of transmission from the pendulum to the clock movement are as follows:



Magnetic Clock Enclosed in Glass Case. It Will Run Continuously Two Years on One Flashlight Battery.

There is no mechanical connection between the pendulum and the movement, and consequently there is no striking or rubbing of any part by the pendulum and no friction; no manipulation is needed to connect the pendulum with the movement. There is nothing to prevent enclosing all the important parts of the clock in an airtight case.

The mechanism for transmitting motion from the pendulum to the movement produces substantially the same drag upon the pendulum whether the clock hands are moving up or down, and consequently the rate of the pendulum and its timekeeping qualities are exceedingly good.

The important parts of the clock movement are enclosed in a tight case partially filled with a fine quality of mineral oil. No dust can possibly enter this case, and the parts cannot become rusty or sticky.

The parts move continuously in oil. No part strikes upon another as in the case of the ordinary escapement, and consequently the movement is absolutely noiseless.

To regulate the rate of the pendulum the following means are employed: A small permanent magnet is mounted beneath the hollow base of the clock so as to be moved against the resistance of a spring by means of an adjustment screw. A perfectly definite force of attraction will be maintained between the end of the regulating magnet and the bottom of the pendulum magnet (C), but the amount of this force of attraction can be varied by the adjustment screw because the force will diminish as the magnet is moved further away from (C) and vice versa.

A very important advantage of this method of regulating is that the clock need not be stopped nor the pendulum disturbed in any way for regulation.

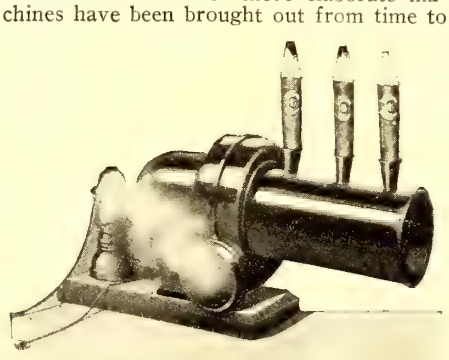
For the purpose of setting up these clocks correctly on a mantel or other surface three leveling screws are provided beneath the base, and a pointer and indicator are on the column and pendulum rod respectively. By these means a person may easily adjust the clock to run on any surface.

WHEN ELECTRICITY "SMOKES" CIGARS.

In tobacco factories and also in many show window displays, it is found desirable to have an electro-mechanical device which will *smoke* cigars in a similar fashion to that followed by mankind in general.

Such an electrical smoker, of neuter gender, is shown in the accompanying illustration. A flexible cord plugged into the nearest electric light socket supplies the miniature motor with power to drive a multiple-vane blower. This blower creates a back draft as becomes evident by the illustration, and thus the *Perfectos* of doubtful vintage, may be smoked rapidly and naturally. The resulting length and character of the ash is noted by tobacco experts.

While a number of more elaborate machines have been brought out from time to time for this particular purpose, the device here described seems to fill the bill at a very reasonable first cost for the apparatus, and also with entire satisfaction in the results obtained.



How Would You Like to Pay the Cigar Bill for This "Electrical Smoker"? It Tests Hundreds of Cigars a Day.

A New Crest Reading Volt-Meter

During the past few years a considerable amount of labor has been spent in developing high voltage measuring apparatus, such for instance as meters which will measure the mean maximum value of a high tension current in which the wave

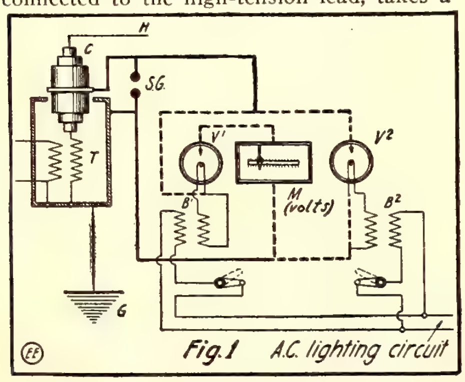
Fig. 2. The Cathode Tube Used in the New Crest Reading Voltmeter Scheme.

produced is not regular. Several ideas were suggested, none of which proved commercially successful. However a special arrangement containing a new form of cathode tube has been used, which shows a remarkable improvement over the other types of meters.

Fig. 1 is a diagram of connections for the crest voltmeter. The testing transformer, T, is in a grounded case; C is a condenser terminal, used to bring out the high tension lead, H. V_1 and V_2 are rectifiers or valves, having anodes of tungsten or molybdenum, and a cathode of incandescent tungsten, working in mercury vapor.

The filament cathodes are heated by the secondary current from the bell ringing transformers, B^1 and B^2, the primaries of which are connected to any suitable A.C. lighting circuit. M is a permanent magnet indicating instrument connected in the anode lead to the valve V^1. A three pole, single throw switch is used to close the cathode heating circuits, or short-circuit the instrument when not in use. SG is a safety gap connected between the leads to the meter to protect the insulation of the apparatus in case of an interruption of the supply to the bell ringing transformers, when the switch is in the working position, or in case of an accidental open circuit in the instrument wiring.

The operation of this device is unusual and interesting. The condenser terminal, connected to the high-tension lead, takes a



Circuits of Crest Reading Voltmeter of the Vacuum Tube Type.

charging current at all times proportional to the rate of change of voltage across its terminals. At both the positive and the negative maxima of the voltage waves this current is zero, and the time integral or area of the current wave between these zero values is a direct measure of the difference between the maximum and the minimum voltages. On account of the unsymmetrical conduction of the cathode valves, the arrangements of circuits shown in Fig. 1 are such that the charging current in one direction passes through the instrument M and the valve V^1, as shown by the heavy dotted line. Current in the opposite direction passes through the valve V_2 without passing through the meter, as shown by the heavy broken line. The thin lines in the figure represent the primary and secondary exciting circuits for the cathode filaments, fed from the lighting circuit. When the meter is not in use the control switch (not shown in Fig. 1) is thrown to the right, which short-circuits the apparatus and opens the primary circuits of the exciting transformers.

The torque of a permanent magnet meter is proportional to the *average value* of the current passing through it, and since for waves of constant length the area is proportional to the average amplitude of the current, it is evident that the meter will give an indication proportional to the time integral of the pulsating current through the valve V^1, and this will in turn be proportional to the crest or peak of the voltage wave.

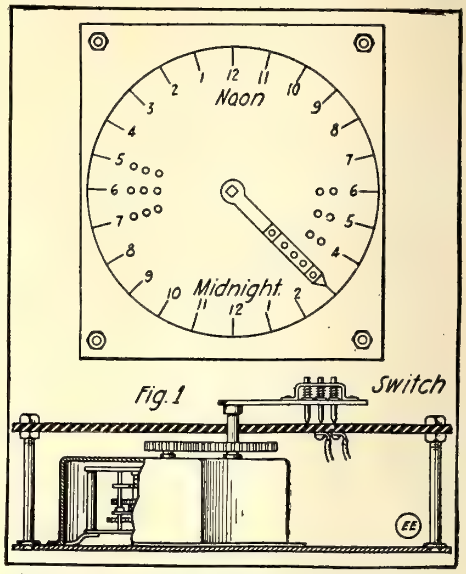
This crest voltmeter is calibrated in parallel with a standard spark gap, or another standardized crest voltmeter and usually the scale is drawn so that it indicates the r.m.s. (root mean square) value of a sine wave having a crest value equal to that of the voltage to which the meter is connected. When thus calibrated it is the equivalent of the needle or sphere gap.

WHAT ONE CENT WILL BUY.

The decreased cost of electric service and the increased efficiency of electrically operated devices are constantly adding to the purchasing power of a cent. On a basis of eight cents per kilowatt-hour one cent will buy: Electric service to light a 25-watt (23 candle power) lamp for five hours; electric service to make ten cups of coffee in an electric coffee-pot; electric service to heat milk in a nursery milk warmer three times; electric service for 300,000 stitches on a motor-driven sewing machine; electric service for twelve cups of tea in an electric samovar; electric service to operate an electric chafing-dish for fifteen minutes; electric service to boil twelve eggs in an electric hot-water cup; electric service for an electric vacuum cleaner for one hour; electric service to warm a heating pad for two hours; electric service for an electric washing machine for one hour; electric service for an electric flatiron for ten minutes; electric service to make ten slices of toast on an electric toaster.

AN AUTOMATIC IGNITER FOR STREET LAMPS.

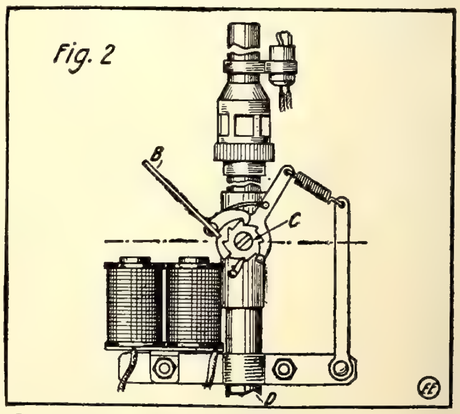
Where gas lamps are utilized for street illumination, there is considerable expense attached to the problem of lighting and extinguishing the gas mantels at night and morning. Besides the employee assigned to this service is not always punctual on his rounds and in consequence some streets are kept in darkness longer than they should be. With these and other objects in mind a New York inventor, Mr. Arthur E. Hynds, has applied for patents on a new automatic electrical igniter and extinguisher. The accompanying illustration will help to bring out the merits of this device which comprises primarily an eight-day clock, for in-



A Clock Motor and Special Switch Attached to It Closes and Opens This Street Gas Lamp Burner Automatically Besides Igniting the Gas.

stance, which controls a specially designed multi-point switch. Owing to the action of the clock the switch functions in the evening and also in the morning. Of course the apparatus may be adjusted for the changing duration of day and night during the seasons.

In the evening the apparatus operates by means of a pair of electro-magnets, Fig. 2, that attracts an iron armature B. In moving toward the magnets the armature, by means of a pawl and ratchet wheel C, opens the gas supply to the mantel at the upper extremity of member D. Just below the mantel is the electric igniter, in the form of a fine wire, which is heated up momentarily and also simultaneously with the opening of the gas valve, as explained. After this action has taken place (in the course of a few seconds), the apparatus resumes its normal condition and no battery current is utilized during the night. In the morning the clock again causes the switch gear on same to actuate the electro-magnets and this time they close the gas valve, as will be understood from the foregoing and the ignition circuit is not closed. After this operation the electrical circuits are not closed for the rest of the day until evening approaches. This invention seems to be a



Side View of Electric Igniter and Valve Control Magnets on New Automatic Gas Burner.

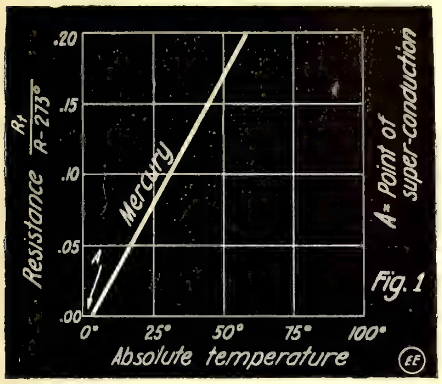
meritorious improvement over existing methods used for the purpose and it seems that it could be adopted by municipalities to good advantage.

The Marvels of Modern Physics

By Rogers D. Rusk, B. Sc.

THE ABSOLUTE ZERO.

THE hardened scientist can juggle queer looking graphs and unbelievably low temperatures in a way to discourage the tyro in the study of heat and low temperatures. However, a brief initiation will introduce him to wonders of amazing interest and of deep meaning. Making snow on the hottest summer day, liquefying a rare gas or producing cold many times as intense as



Graphic Curve Demonstrating Clearly How the Resistance of Mercury Decreases Almost to the Vanishing Point with Falling Temperature.

that endured by the arctic explorers are common-place matters in the laboratory, and the laws and relations discovered through such experiments aid much in clearing up the hidden meaning of things.

One immediately asks if there is any relation between temperature and electricity, for electricity is the one big vital force which interests us all. Yes, a current in a wire will generate heat, and heat, on the other hand, applied to a thermopile will generate electricity, but more than that the resistance and magnetic susceptibility of all substances are so affected as to produce strange phenomena to be noticed at very low temperatures, especially near the *absolute* zero.

The absolute zero, it must be remembered, is the point of lowest possible temperature, far below the zeroes of the Centigrade and Fahrenheit scales. Hot and cold are relative terms. Ice may be warm when compared with frozen mercury at –40 deg. Cent., for in reality hot and cold are only varying degrees of warmth, and a body absolutely cold would be one from which *all* heat was absent. Its temperature would then be at *absolute zero*. Little more than a quarter of a century ago the lowest temperature then reached had been produced by a freezing mixture of salt and water, the minimum for which was –22 deg. Cent. Today we have succeeded in going nearly 250 deg. below that—a big step in twenty-five years, and very close to the absolute zero which has been assumed to be at –273 deg. Cent. Now the location of this point was a puzzling problem. Let us take the definition of heat which says that heat is the energy of molecular motion, then the point "no-heat" or absolute zero would be the point where all molecular motion ceases. To understand this fully it is necessary to know something of the mechanics of gases. Every volume of gas exerts a pressure on the walls of its containing vessel by reason of the kinetic energy of the molecules which keeps them rapidly vibrating, colliding with one another, and bombarding the walls of the containing vessel. If heated, the gas expands, due to an increase of kinetic energy, causing greater vibration, more collisions, and hence higher pressure on the walls of the container. The converse is true if the gas is cooled, and extreme cooling would finally cause all kinetic energy to disappear, all vibration to cease and the pressure to become zero. Hence the volume would also be reduced to a point or zero.

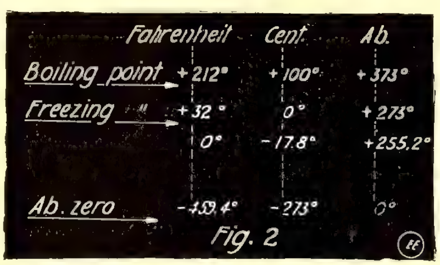
A century ago Gay-Lussac found that all gases have the same temperature coefficient of expansion which is 1/273 of their volume at zero. This amount of contraction per degree would mean that at –273 deg. a gas would contract 273/273 of its volume or vanish. If we consider solids instead of gases, we find that their varying coefficients of expansion cause their zero points to be widely different. Mercury for instance vanishing at –5500 deg. Cent. However, because a gas is the simplest form of matter, and because all gases have the same vanishing point, we assume their zero to be the most reasonable one to take as absolute.

The apparent impossibility of reaching such a point where gases vanish and all molecular motion ceases, indicates that we will probably never attain the absolute zero, although in experimental work we may approach it as a limit.

We may classify the different means of producing low temperature under three general heads:

(1) By freezing mixtures.
(2) By evaporation.
(3) By expansion.

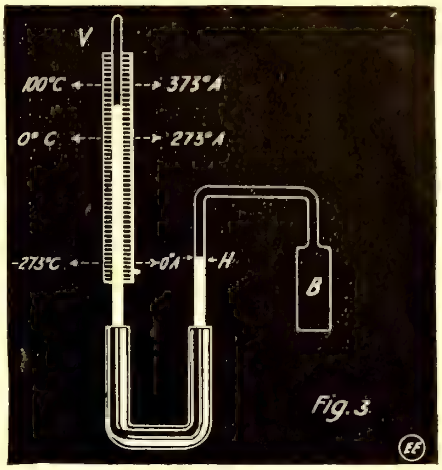
Everyone knows that salt thrown upon ice will cause it to melt, due to the chemical attraction of the salt for the particles of water, and even though the temperature be as low as before the salt water will not refreeze. The reason is that its freezing point has been lowered and it must now be cold enough to both separate the water from the salt, and freeze the water, whereas before it had only the latter to do. Such a freezing mixture is called a cryohydrate,



Comparison of the Fahrenheit, Centigrade and Absolute Temperature Scales. The Absolute Scale Measures All Temperatures in Positive Terms or in Degrees Above Absolute Zero.

and in the case of salt, a proper solution may be reduced to –22 deg. Cent. before freezing; if sodium bromide is used, to –24 deg. Cent., and if calcium chloride is used, to –55 deg. Cent. Such a low temperature is actually produced because the ice absorbs the heat as it melts. The latter is about the lowest possible temperature attainable with a freezing mixture.

A number of gases have been liquefied by compressing them at ordinary temperatures, such as sulphur dioxide, carbon dioxide and



The Gas Thermometer Employed in Measuring Extremely Low Temperatures. Bulb "B" Filled with Hydrogen Gas as Mercury Would Solidify.

ammonia. When condensed they must be kept at a constant temperature. Many other gases, known as the permanent gases, cannot be liquefied by pressure alone because they must be cooled below a certain point for each gas, known as the critical temperature. If the gas is not cooled to this point no amount of pressure will liquefy it. Methane gas must be cooled below –82 deg. Cent., Nitrogen below –146 deg. Cent., Hydrogen below –241 deg. Cent., and Helium below –268 deg. Cent. To liquefy the latter is a task indeed.

A drop of ether or chloroform on the hand feels cold, due to the heat absorbed from the hand when it evaporates, and this suggests to us one of the best methods of obtaining low temperature—by evaporation. For instance, carbon dioxide may be liquefied at ordinary temperatures, but when evaporated it produces the low temperature of –78 deg. Cent.

Our foremost investigator of low temperatures today is Kamerlingh Onnes, of Leyden, Holland, who has produced lower temperatures than any other scientist. Onnes evaporates one gas to cool another below its critical point, and the latter on evaporating produces a still lower temperature. This process might be carried on *ad infinitum,* if it were not for various limiting reasons. In one instance he evaporated methyl chloride in order to cool and condense ethylene, which was then itself evaporated to cool and liquefy oxygen. When the oxygen was evaporated under reduced pressure it gave a quite constant temperature of –217 deg. Cent. By a more complex process, helium was liquefied, and upon evaporating it under reduced pressure, Onnes obtained the marvelously low temperature of –271.6 deg. Cent., or within less than two degrees of the absolute zero.

A third method of cooling can only be mentioned which depends upon the principle that gases upon expanding absorb heat. By this method alone fairly low temperature may be produced, and it was this principle combined with the method by evaporation, which enabled Onnes to liquefy Helium.

(*Continued on page 456*)

The RADIO LEAGUE of AMERICA
HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.
H. Gernsback, Manager

President Wilson Opens Centennial by Radio

By W. H. Kirwan (9XE)

FOR the first time in the history of the United States, the President opened a celebration by wireless on Monday, June nineteenth, the message having been received by an amateur station. For the first time in the history of the country, real Americans (Indians) received a wireless message direct from the "Great White Father."

The Centennial at Fort Armstrong, Iowa, was an event of great moment for the people of the Middle West. One hundred years ago the old block-house, called Fort Armstrong, was built on Rock Island Arsenal. To-day an exact duplicate of it has been erected in the same location. To commemorate this historical event and rebuilding of the new block-house, the people of the Middle West arranged one of the greatest historical and home-coming events ever witnessed.

One hundred years ago old Black Hawk, the chief of the Sacs and Fox tribes, held sway in this territory and ruled as a king. To-day his descendants joined with the white folks in celebrating the Fort Armstrong Centennial. Several of his direct descendants were present, among them being his grandson, Logan Ka Ka-Que, and his great-grandson, Jes Ka-Ka-Que, together with numerous squaws and papooses, descendants of the remnants of the once powerful tribe.

The author was commissioned to open the Centennial by wireless, and arranged with Mr. Tumulty to have the President press the button to Arlington, NAA, and open the Centennial officially at 12 o'clock noon, Central time. The President had agreed to this arrangement and at 1 p.m., Eastern time, June 19, 1916, Arlington sent the long dash, officially opening the Centennial. This was followed by a characteristic message from our President, which is quoted below:

"To the People of the Middle West: I fear that it is only too certain that I shall be bound fast here and that it will be impossible for me to be present, but I shall, of course, take real pleasure in complying with the request to press the button which will signal the opening of the celebration. I am complimented that you should desire me to do so.

"Woodrow Wilson."

The great-grandson of Old Chief Black Hawk was *listening in* at the signals and, for the first time in history, one of the real Americans received a wireless message from the President. At the moment the dash was received from Arlington a signal was given to the grandstand and numerous balloons were liberated and also a large number of white doves, being the Symbol of Peace, and the American flag was hoisted to the top of the mast, while the band played "The Star-Spangled Banner." It may interest readers to know that the great-grandson of Black Hawk is quite an intelligent man and knows considerable about wireless telegraphy.

The author made arrangements with several wireless companies who kindly loaned the necessary instruments and a large tent was erected on the Rock Island Arsenal, as the official wireless headquarters. The local members of the Davenport Radio Club were given full charge of the station and, with the assistance of the Boy Scouts, soon had the aerial erected, a single wire 500' long, 60' high. A ½ K.W. sending set was installed in the tent, and messages were sent and received from the surrounding cities. Several of the boys were on duty at all times and slept in the tent.

Of the many thousand visitors to the Rock Island Arsenal during this memorable week, it is safe to say that very few of them left the Arsenal without viewing the wireless outfit and asking innumerable questions. A few copies of THE ELECTRICAL EXPERIMENTER, which were on exhibition at the wireless tent, were worn to a frazzle. Some of the visitors had never seen a wireless outfit at all, as they had been living far removed from railroads and civilization for a great many years. Many of them were permitted to hear Arlington send their routine report and time during the week and all expressed astonishment at the clearness of the signals. An Oscillaudion bulb was used and was lit continuously the whole week, but did not seem to affect the storage battery which was used for the purpose of lighting the bulb alone.

Radio Receiving Set Installed for the Centennial at Fort Armstrong, Iowa, and Over Which American Indians for the First Time Heard a Wireless Message From President Wilson.

Each year the amateurs of the United States are doing something unheard of and the author was greatly pleased to have started off the present year with a National Radio Relay that reached from coast to coast. With this event, which is really history, the amateurs have again demonstrated their ability to do things by opening one of the largest Centennials in the Middle West by Wireless, direct from the White House, and without any help from the commercial stations.

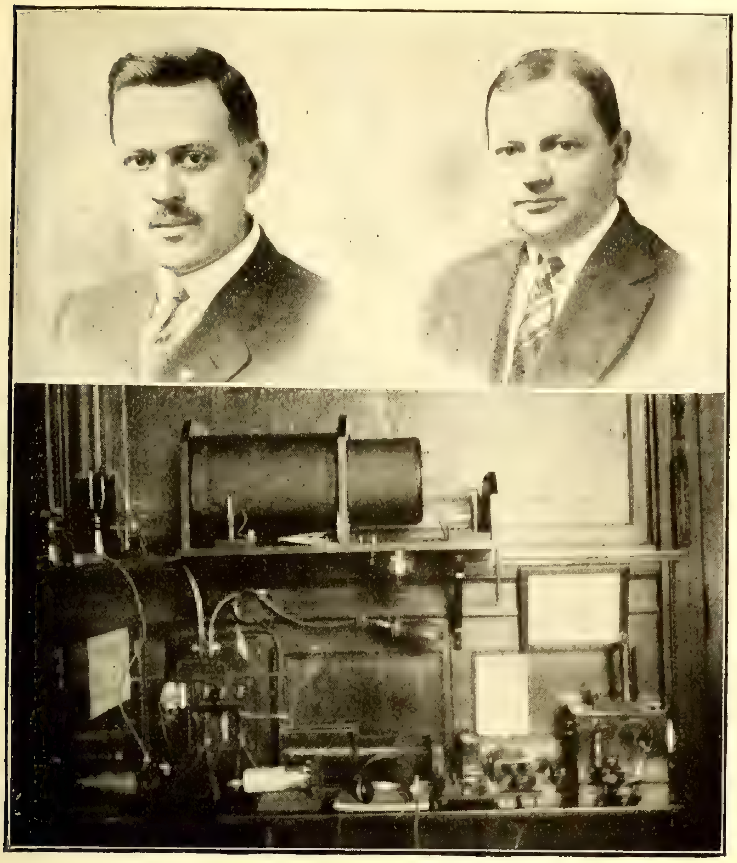
The Wireless Outfit was as much of a curiosity and point of interest to the Army officers at the Rock Island Arsenal as to the visitors because, as will be remembered, the relay of February twenty-second, which was sent in the interest of Preparedness, was started from Rock Island Arsenal at the suggestion of Colonel Nicholson, whose name, however, was badly twisted by a great many of you before it reached both coasts. Rock Island Arsenal does not have a wireless installation and we think this is peculiar, but it is surrounded by a number of adjacent amateur stations, which can receive messages direct from Arlington, NAA, Lake Bluff, Ill., NAJ, and various other Government stations. The amateur stations are also situated around the Arsenal in such a way that a man with the semaphore signals could easily send any messages direct to the Arsenal from any of these amateur stations.

For the benefit of those who assisted the author in his several relays, it may be of interest to know that another relay of *International* importance is being arranged for September, as well as a very complete and efficient testing arrangement, so as to get the real ranges for sending and receiving of the various stations, some of which are boasting of unheard of distances. This event will be of great importance to all the amateurs in the country, and the author's advice to you is to read THE ELECTRICAL EXPERIMENTER regularly, so that you

will get all the instructions necessary. Tell all of your local radio amateur friends about it.

gave a brief talk on the "Elementary Mathematics of Aerial Construction." The semi-annual election of officers was also held at this meeting. William A. Le May was chosen as president to succeed Wendell W. King, who enters Union College this fall for a course in electrical engineering. John T. Zimmer succeeds Mr. Le May as vice-president, and E. Malcolm Williams succeeds Harold G. Connor and Charles E. Everingham as secretary and treasurer respectively. John D. Adams and Mr. Zimmer were elected station inspectors. During the summer months but one meeting a month has been held. This association solicits correspondence from western radio clubs. Communications should be addressed to the secretary at No. 1627 Seventh Avenue, Troy, N.Y.

The club has a number of new ideas.



Mr. Muhlheizler (left) and Mr. Weaver (right) Who Explained Their Undamped Wave Audion Receiving Outfit to Members of the "Western Pennsylvania Radio Society" at a Recent Meeting of the Society.

The Amateur Marconi Radio Association of Troy, N.Y.

THE photo here shown is one taken while several of the members of this club were out testing the portable sets shown to the right.

At the last meeting of the A.M.R.A. the club was addressed by Roland B. Bourne, a former commercial wireless man, who spoke interestingly on the "Alternator frequency-changer method of transmission," as employed at Tuckerton. Delegations from the Albany and Schenectady radio associations were present and it is planned to conduct tri-city radio conferences. It was decided to postpone the erection of a semi-powerful station on the Troy Y.M.C.A. building until fall. As can be seen in the photo, two portable sets are available and extensive tests are being carried out during the summer. E. Malcolm Williams

Wireless Activities in Western Pennsylvania.

THE Western Pennsylvania Radio Society held a general wireless meeting a short time ago in the Miller Building, Fernando Street, Pittsburgh. An undamped wave receiving set has been installed here by Messrs. Mühlheizler and Weaver, of the Pittsburgh and Allegheny Telephone Company, who were in a great measure responsible for the establishment of the society a little over two years ago. The society is composed of about eighty amateur operators of this section of the state and has been instrumental in developing a great amount of interest in wireless telegraphy and in providing a clearing house for the ideas of its members. The society meets quarterly. At this last meeting the operation of the undamped system was explained by the two P. & A. Co. engineers and was of particular interest to the amateurs.

The accompanying photograph shows the large loose coupler wound with No. 28 s.s.c. magnet wire on tubes 8" and 10" in diameter and 15" long, thus getting a sufficient wave length so that primary and secondary *loading inductances* (as are required in the Armstrong circuits) are dispensed with. The large loose coupler is the main feature in this set.

An oscillating vacuum detector is wired in the small box shown to the right. An operator's telephone key is used to cut in either the large or small loose coupler. Another similar key changes from mineral to audion. The question is often asked—"Will an undamped wave receiving circuit receive damped waves?" We find that it will, but not as efficiently as with the ordinary damped wave hook-up.

Before building the large loose coupler we used the damped wave circuit, Fig. 1, on the small loose coupler. When the large loose coupler was installed we changed the vacuum detector box wiring to Fig. 2 (undamped), which works well on undamped but not so well on damped waves. We intend to get another bulb and wire it for Fig. 1 (damped) or arrange several telephone keys to change the audion circuit from damped to undamped, unless we can discover a combination that works equally well on damped and undamped waves.

It might be mentioned that the primary of the large loose coupler contains 900 turns of wire. The first switch tap takes 400 turns and each succeeding tap 50 turns. The secondary has 1,100 turns and is tapped out every 100 turns. When one begins to get undamped waves the first thing that strikes one is that there is as much difference between damped and undamped waves as there is between day and night. We hear practically all the large undamped waves commercial stations and would recommend a large loose coupler in preference to a

(Continued on page 456)

RADIO AND WIRE TELEGRAPHERS IN DEMAND.

The greater use to which wireless telegraphy is being put daily, has caused an ever-increasing demand for operators of the instruments. This is a field that is not overcrowded and little likelihood of becoming so for a long time. Old hands at the Morse system are going to the Marconi system, and yet the demand for both male and female operators continues to increase. Telegraphy is a business easily learned and salaries for it are good, ranging from $14 to $30 per week.

AMATEUR WIRELESS IN HOLLAND.

It is reported that a movement is on foot to start a wireless society for Dutch amateurs. There are many keen wireless amateur enthusiasts in Holland, and accordingly there should be no difficulty in forming a wireless organization comparable to many in the United States.

The Members of the "Amateur Marconi Radio Association" of Troy, N.Y., Recently Conducted a Successful Field Test on Their New Portable Radio Outfits.

Some Interesting New Radio Apparatus

IN the two previous issues of *The Electrical Experimenter*, several commercial type instruments have been described in detail and in this issue we take pleasure in showing several miscellaneous instruments of the latest design for use in radio work.

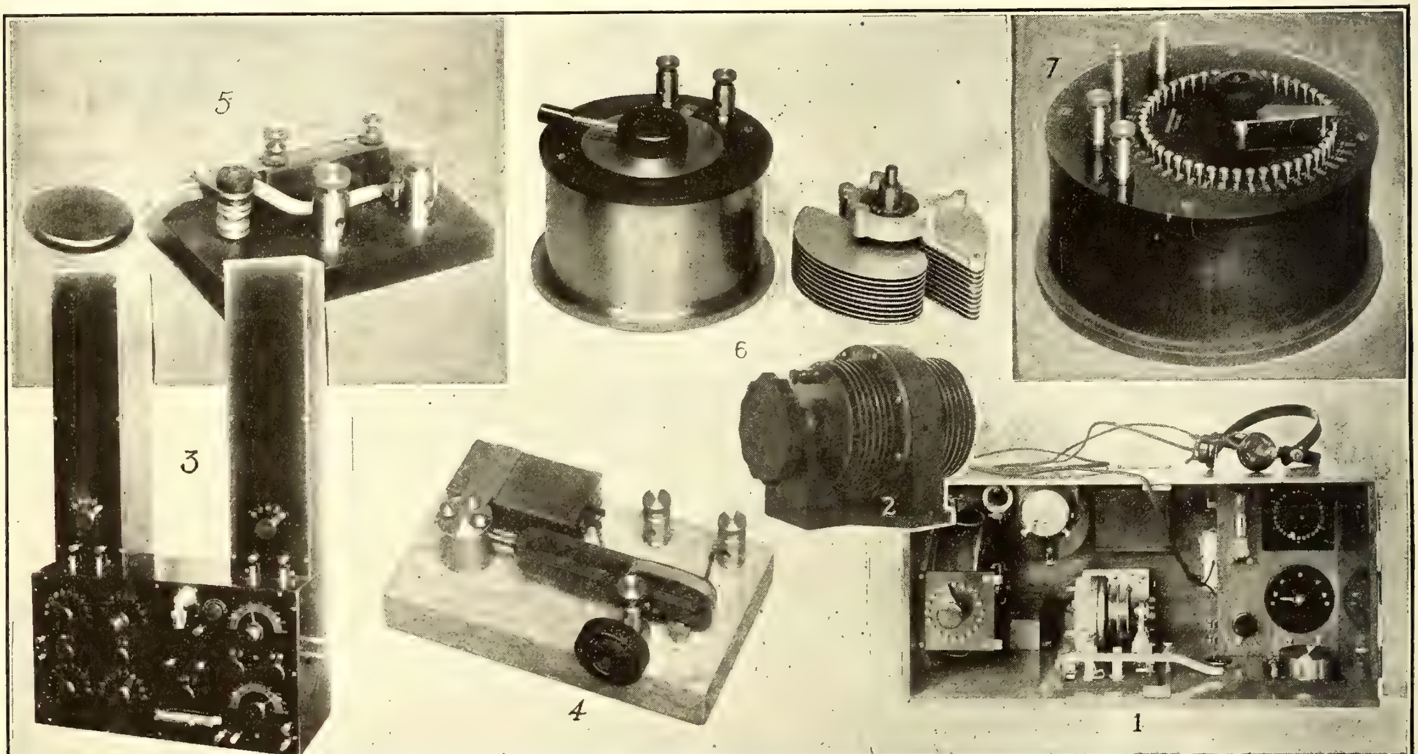
A 1/6 K.W. aeroplane outfit is shown in Fig. 1. This set is equipped with a Chaffee gap, shown behind the key. The distance between the electrodes is controlled by an insulated knob. The oscillatory circuit is composed of an oscillation transformer, at the left, the inductance of which is regulated by multiple-point switches on both primary and secondary. The capacity comprises a mica condenser secured to the base to the right of the oscillation transformer. The two coils seen on top are impedances for controlling the current in the gap. The receiving outfit consists of a special inductively coupled tuner, variable condenser, loading coil and a vacuum detector, as shown at the right. The instrument in front of the receiver is a high frequency buzzer, used for testing.

The complete unit is placed in a substantially built case to make it compact. The outfit is said to weigh only thirty pounds, which is remarkably light as compared with most other types of aeroplane radio apparatus. The generator which supplies current to the arc is placed in front of the machine and is fitted with a propeller so that the powerful air currents produced when the machine is in motion, rotate the dynamo. Tests have proven that the outfit is thoroughly satisfactory for the purpose outlined.

A photograph of the Chaffee gap is illustrated in Fig. 2. The sparking terminals are enclosed in a gas-tight chamber and each copper electrode is fitted with a number of radiating fins to keep the electrodes cool when they are in operation. The spark is produced in an atmosphere of hydrogen gas, the connections being made from the ends of the vanes, while the sparking distance is regulated by the large knob. This gap operates on 500 volts direct current and is rated at ¼ K.W.

A very efficient and well designed radio receiving set is shown in Fig. 3. It is capable of receiving stations having a wave length of from 200 to 20,000 meters and the circuit is so arranged that it is possible to hear both damped and undamped transmitters. This is done by the Armstrong regenerating circuit, which has been described in previous issues of this journal. The aerial loading coils are on top of the cabinet. The set itself is made with an inductively coupled tuner, the switches of which are located on the left. Two variable condensers are placed on the right, a vacuum detector being used. It can be connected in such a manner as to cause it to oscillate for undamped wave reception. This is a good model for the amateur to duplicate as it is particularly well designed.

A buzzer which produces a tone of definite frequency has been in demand for many years. Such a buzzer is illustrated in Fig. 4. This instrument develops a frequency of 500 cycles, which is the exact tone of most radio transmitters used both on land and on shipboard. The apparatus consists of an oblong electro-magnet placed between the prongs of a tuning fork emitting a 500 period note. This represents the vibrating membrane of the device, and it is supported on a standard by a single rod from the tuning fork, thus giving the ends a free motion. A platinum contact is secured to one end of prong while the other is fastened to an adjustable screw. A rubber knob is placed on this screw for regulating purposes. This is seen supported on a binding post in the foreground. The electro-magnet and the adjustable electrode are connected in series while the other terminals are made with the two binding posts



Radio Apparatus Shown Above—1. Compact Aeroplane Set. 2. Chaffee Gap. 3. Receiving Cabinet for Damped and Undamped Waves. 4. 500 Cycle Hytone Buzzer. 5. Transmitting Key. 6. Variable Condenser Giving a Straight Line Calibration Curve. 7. Audibility Meter for Measuring Intensity of Received Signals.

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AMONG the hundreds of new devices and appliances published monthly in The Electrical Experimenter, there are several, as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnished to you, free of charge, by addressing our Technical Information Bureau.

NEW SYSTEM OF RADIO TELEPHONY.

The radio engineer of today is still laboring on the important problem of transmitting speech without wires, and recently various systems have been developed, one of which was brought out through the research of Edward G. Gage, a well known radio investigator of New York City. His system has been thoroughly tested by the D.L.&W.R.R. at their Hoboken station, and the results obtained are more satisfactory than from other apparatus previously tested.

The high frequency alternator employed for producing the sustained waves is a modification of the Fessenden type. A remarkable feature of this mahcine is the fact that it runs at a tremendous speed of 40,000 R.P.M., just double the speed of the Fessenden or Alexanderson machines. The alternator used at Hoboken is driven by a 3-horse-power motor run by 150 storage batteries. This is done to secure constant speed regulation.

The control panel is illustrated in Fig. 1. At the right of the panel are two circular cases. In these the inductances are placed, controlled by a circular switch. The upper one is used as a secondary inductance, while the lower one is the primary. The amount of current which is radiated by the antenna is read on an ammeter, beside the inductance. The modulated current is controlled by a specially designed microphone placed in front of the panel. This microphone is provided with a water cooling system, so that if a large amount of current is to be controlled, water is sent through it to cool the microphone elements and their chamber. A special form of mouthpiece is employed to collect all the vibrations of the voice. At the left of the microphone can be seen the Fessenden electrolytic detector for receiving. A key, which is used for calling is mounted at the right of the microphone.

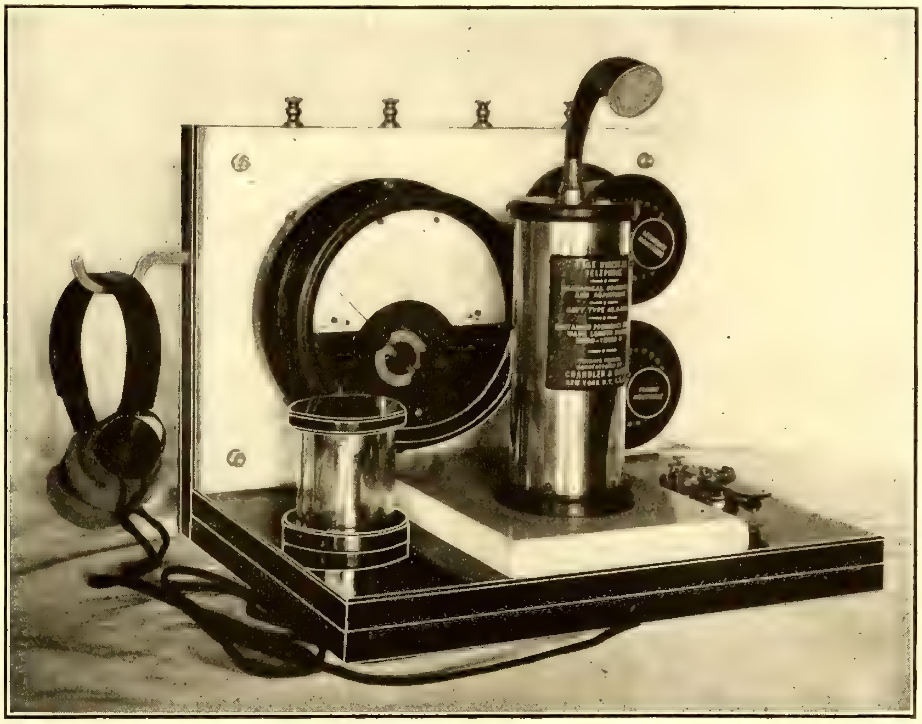
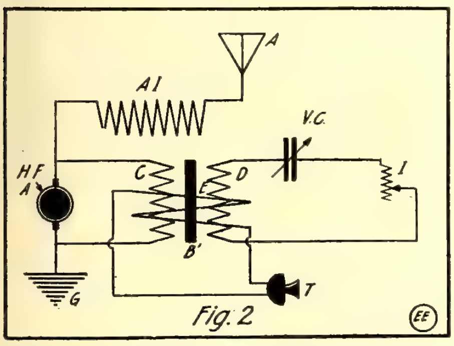


Fig. 1. Control Panel, Switch Hook, Microphone, Detector, Etc., Used in the Gage Radiophone System.



Circuits Used with the Gage Radio Frequency Alternator System of Radiophony.

The novel transmitting circuit which is actually used in this new system is shown in Fig. 2. The high frequency alternator is connected directly in the antenna and ground circuit as indicated, and is shunted across a receiving coil C of a three coil transformer B. The second coil D, of this transformer is connected in series with a variable condenser VC, and an adjustable inductance I. The third coil E is linked to a telephone transmitter. This coil is wound over both of the other two coils CD. The principle involved is the modification of the antenna current by detuning.

In operation, when the telephone receivers are removed from the hook, the generator is automatically started, and thereafter no adjustments are necessary as long as the generator is run at a constant speed. A small button operates the change-over switch. From two or three amperes are usually radiated from the antenna.

The complete system has been employed in a series of tests by Mr. Gage, at a testing station on Long Island Sound. The National Electric Signaling Company cooperating in this work, with their apparatus on Fall River line steamers.

The use of the high frequency alternator makes it particualrly applicable to railroad work, since it requires practically no adjustments. One objection is, of course, the expense of an outfit, but it is believed this can be reduced sufficiently to make it practical.

RADIO TELEPHONY ON THE MEXICAN FRONT.

Although many people imagine that the Mexican government has been asleep in regard to radio communication affairs, yet that idea is somewhat incorrect, as that government has today fourteen excellently equipped radio land stations and several portable radio telegraph and telephone outfits which are expected to be used on the border if any hostilities occur between the Mexicanos and ourselves. The illustration shows one of five Mexican portable radio outfits, which can either be used as telegraph or telephone transmitters.

The transmitter consists of an arc generator of the quenched type, placed on the side of the cabinet as shown in the upper left corner. The fan below the gap is used for cooling it when in operation. The variable condenser and aerial inductance are mounted on the same panel as the arc. The current for the arc is obtained from a high voltage, direct current generator, not shown in the photograph. Either the telegraph key or telephone transmitter can be put in circuit by changing the double-pole switch located on top of the case. The key is shown next to the change-over switch, while the microphone is supported on a frame on the front panel. This is of a special design consisting of two microphones connected together by a single horn. In this way a larger amount of current can be controlled.

The receiving instruments shown standing to the right of the transmitter are of the Audion type, which comprises a standard inductive coupler, the inductances of which are controlled by switches. The primary of the tuner is connected with a loading coil to permit reception of high wave lengths. This is also regulated by means of a switch. Two variable condensers are enclosed in the same case, the variations of which are obtained by turning either of two knobs mounted on the panel. The detector em-

Photo Copyright by Underwood & Underwood.

The Mexicans, Contrary to Public Opinion, Have a Number of These Radiophone Outfits of the Latest Type.

(*Continued on page 459*)

NOVEL RADIO APPARATUS.

A number of efficient radio transmitting and receiving apparatus have recently been developed by Mr. E. C. Mignon, the well-known radio engineer. Herewith is illustrated a new vacuum detector cabinet, receiving set consisting of a special loose coupler with units and tens adjustments in the primary and a ten-section variable secondary, a large ten-section loading inductance, and a duplex rheostat for the minute regulation of filament battery by two separate terminal switches of special resistances. The filament current is cut off by turning upper rheostat switch lever to extreme left and off the contact points; this prevents the lighting of the Electron Relay filament without the use of the protecting resistance. Further, there is a small fixed condenser of special design, 2 F. M. condenser, and a 43 plate rotary variable condenser and a Master switch. This cabinet set is equipped with a Rotary Inter-Change switch, enabling the operator to use either Bulb or Mineral detectors by simply turning one knob, which automatically establishes either circuit, leaving no dead-ends or unnecessary closed circuits. A large ten section variable loading inductance gives this set a very high wave length capacity. The 12 3-cell flashlight high tension battery is controlled by a 9-terminal silent switch, the lever traveling on a perfectly smooth surface, without the use of dead contact points. A six volt storage battery or three to four ordinary dry cells connected in series, are required to operate this set. A special complex bulb circuit is employed in this set as will be noticed in the accompanying photograph, by the auto-transformer encircling the vacuum bulb.

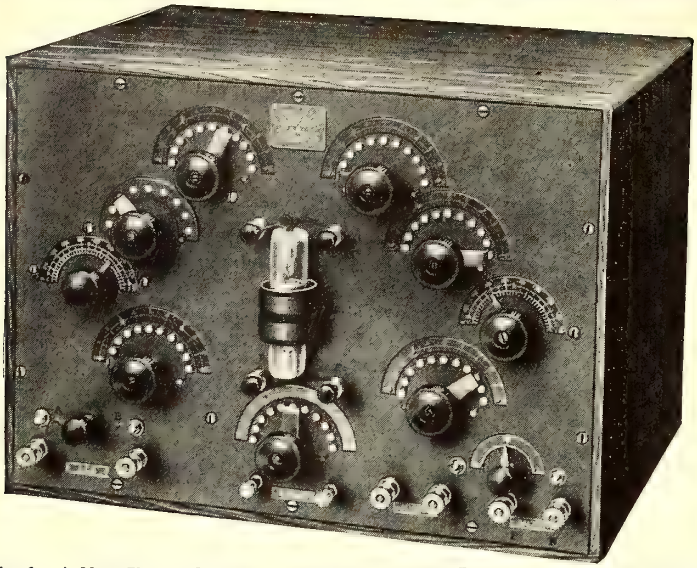


Fig. 1. A New Type of Radio Receiving Cabinet Provided with a Vacuum Tube Detector and Auto-Transformer Wound About the Tube as Seen.

The auto-transformer consists of a fiber tube 1⅜ inches in diameter and 1⅜ inches in length; the windings are of No. 22 B. & S. double silk covered magnet wire with 14 turns to each coil. This transformer is of distinct importance when using the apparatus for receiving undamped waves since its magnetic field oscillations are in absolute synchronism, consequently stimulating the periodical electron discharge from the filament and the ionization of gas within the bulb by the heat of the filament the manufacturers claim.

The interchange switch (at lower left of cabinet) consists of a hard rubber rotating rod carrying two sets of strips for the connecting of spring finger contacts; the first five make connections for bulb detector and the second two for mineral detector circuits. Fig. 2 shows the hook-up of the various parts of the receiving set.

It should be noted that the small fixed condenser in the grid circuit and the 2 mf. condenser in shunt with the high tension batteries are of a new type, which has proven far superior to the usual plate affair. The form of cable used in all of these sets is made up of two D.S.C. magnet wires, wound on together at the same time; these two wires, coiled, were found to be more efficient than any other winding tried out by Mr. Mignon.

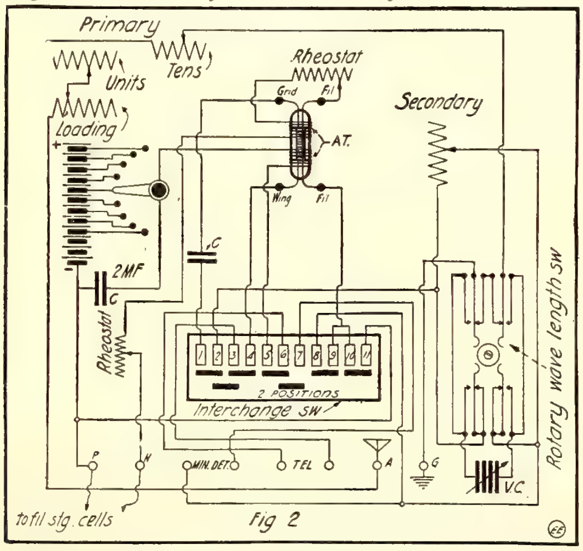


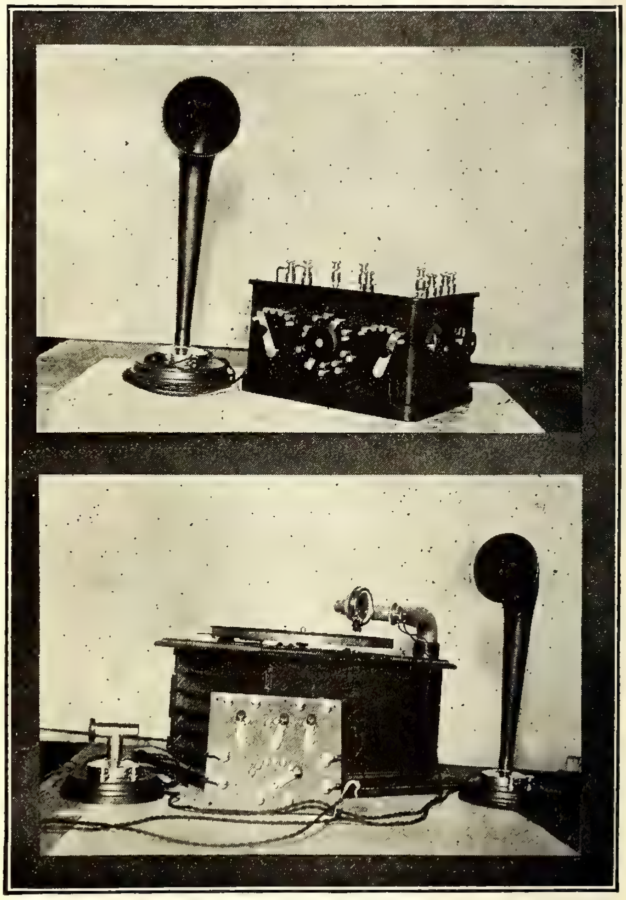
Diagram of Connections for Cabinet Receptor Pictured Above.

AN IMPROVED AMPLIFIER FOR RADIO AND PHONOGRAPHS.

The long standing need of a suitable amplifier for the radio experimenter has recently been filled by Leon Bishop, the well-known inventor, who has devised a successful, double-step, microphonic amplifier for use in boosting the incoming signals.

The instrument is herewith shown and consists of two sets of microphones actuated by a solenoid electro magnet. A description of the constructional details of the sensitive element was given at length in the October 1915 issue of *The Electrical Experimenter*. The control for both microphones are located on the side of the instrument case as indicated at the right. The two outside switches vary the current in the low resistance circuit, while the center one controls both amplifiers so that they may be both in tune with each other. Two small induction coils are interposed in each amplifier circuit so as to obtain the maximum effect with a minimum current.

A considerable amplification is obtained with this instrument and with the use of a loud speaking telephone, messages can be heard quite a distance from it. The sound magnifier seen standing to the left is used in conjunction with the amplifier and it is used as a desk instrument. This is nothing more nor less than a low resistance telephone receiver fitted with a horn. Amateurs who are interested in radio amplifiers will certainly find this one very satisfactory.



Above:—New Two-step Amplifier Adapted to Radio Receiving Work and Telephony. Below:—Special Form of Amplifier for Use on Phonograph so that Music May Be Heard Anywhere About the House or Garden.

A sweet strain of music emanating from a bush in the garden—the sound of a brass band coming from all sides of a room—such was the problem before many musical investigators who have sought for years to devise some means whereby music can be, for instance, transmitted to the different parts of a building with the aid of a single transmitter. This problem was at last solved in a simple manner by Mr. Bishop, who employs a single phonographic machine fitted with a microphonic amplifier connected to several loud speaking telephones which are stationed in different locations.

A single phonographic equipment is shown here. The microphone is of minia-

(Continued on page 460)

WIRELESS NEWS PICKED UP 7,000 MILES AWAY.

The wireless station at Sabang, Dutch East Indies, has recently been able to hear German war news being telegraphed by radio from Nauen, near Hanover, Germany, and British messages sent from Carnavon, Wales, a distance of approximately 7,000 miles.

The successful transmission is taken as indicating the desirability of the establishment of wireless communication between Holland and her Far Eastern colonies.

CARRIER PIGEONS AND RADIO WAVES.

French scientists are inclined to think that carrier pigeons are influenced by magnetism and that, with the growth of *wireless telegraphy*, much less dependence can be placed on them.

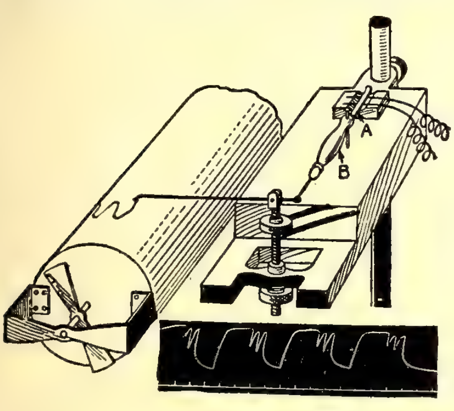
FROG'S LEG MAKES IDEAL RADIO DETECTOR.

Some time ago, attempts were made to utilize the leg of a frog as a radio-telegraphic detector. The illustration shows how it can be arranged to trace an undulatory curve on a revolving cylinder. The final graphic representations of the Morse signals are also shown in the illustration.

In utilizing the frog's muscle for recording wireless messages, the sciatic nerve of the leg is connected with the microphonic circuit of the receiver. One end of the leg is fixed to a base and the opposite end connected with a pivoted lever, as indicated in the illustration, so as to record on a slowly revolving, paper-covered drum the contraction of the muscles caused by the electric impulses.

As pointed out in a very interesting new work entitled, "New Concepts in Diagnosis and Treatment," by Dr. Albert Abrams, this arrangement is many times more sensitive than popularly supposed. Dr. Abrams in his interesting researches concerning the effects of extremely slight and almost immeasurable electric currents upon the human system, and particularly upon the human stomach, has found that for one thing, the ordinary stomach is many times more sensitive to slight electric charges or currents than any galvanometer or like device.

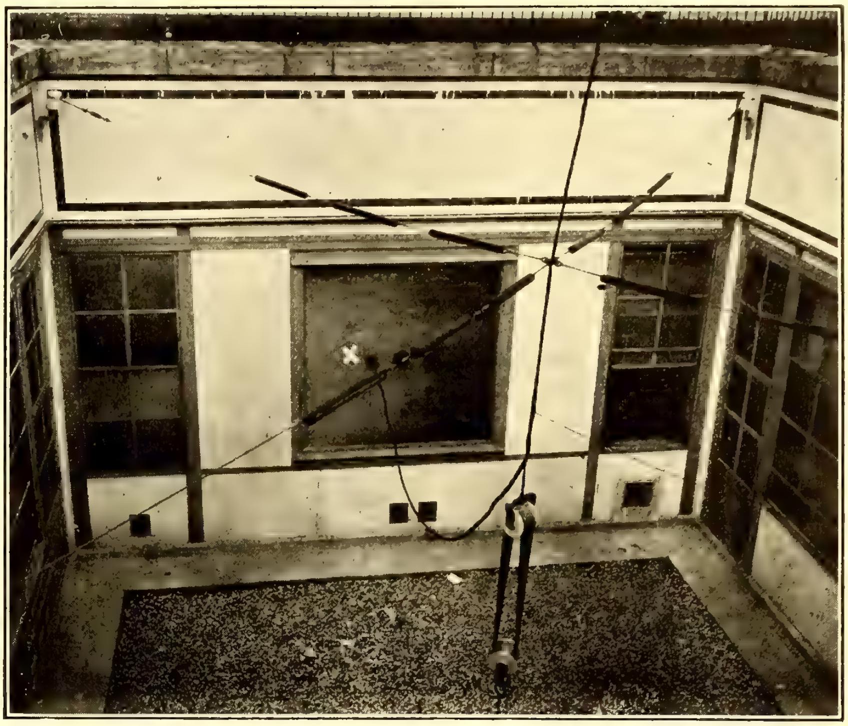
In the case of the frog's leg, for instance, as here employed, it has been found that the production of energy is many times more than the energy involved in the stimulus employed. Thus, in the familiar experiment with a frog's gastrocnemius, the mechanical work of the muscles called forth, is about *38 times the active force involved in the stimulus.* In other words there has been effected an amplification of 38 times the initial energy. It looks, therefore, as though all the ambitious *Radiobugs* will have to move to the country, where the *gastrocnemius* proceedeth to multiply and fatten to sufficiency.



How a Frog's Leg Muscle May be Used to Record Radio Signals. It Amplifies 38 Times!

Lead-in of the Eiffel Tower at Paris, France

The accompanying illustration brings out some practical features in the guying and insulating of lead-in terminals from large radio antennas. The particular one here shown is that at the base of the powerful Eiffel Tower radio station at Paris, France.



The Lead-in Arrangement at the Eiffel Tower Radio Station in Paris, France. Note How the Stranded Cable Is Guyed by Insulators to Keep It Away from Walls. Lead-in Is Taken Into Radio Room Thru Sheet of Insulation.

Radio experimenters in general manifest a marked tendency to employ any old makeshift for a lead-in. On the other hand this is one of the most important parts of any radio station, especially where transmitting apparatus is used, as the high voltage current always tends to dissipate a large portion of the outgoing energy before it reaches the antenna proper, and in this way reduce the efficiency of the station a very appreciable degree.

In the illustration here presented, it will be noted that the lead-in, which is constructed of a number of fine wires stranded together, is guyed from four directions with a number of high voltage insulators connected in series in each guy wire. The vertical tension on the lead-in cable is taken up by two large spool insulators, as shown, which are joined by an insulating strand of pure rubber.

The lead-in cable goes to a metal rod passing through the panel in the side wall of the radio room, the panel being constructed of hard rubber. For small stations it is very good practice indeed to have a metal rod locked in position at the center of a hard rubber or glass panel about one or two feet square. In this way the leakage co-efficient is rendered extremely low and thus the efficiency of the station is kept high. It is indeed surprising, upon visiting a great many experimental and wireless stations, to note the extremely flimsy and inefficient lead-in arrangements their owners will tolerate. A stranded lead-in terminal, equal in conductivity at least to all the multiple wires in the antenna, should be used in every case where the best possible results are desired.

HEAVY INCREASE IN SPANISH RADIO BUSINESS.

The traffic of the Spanish International Wireless Telegraph Company has increased from an average of 800 words per day before the war to an average of about 6,000 words, exclusive of diplomatic correspondence, through the monopoly it enjoys in the transmission of wireless messages from abroad.

The Spanish company has two receiving stations, one at Barcelona and the other at Aranjuez, near Madrid. They receive French news from the Eiffel Tower and from Lyons, German news from Nauen and Norddeich, British news from London and Carnarvon, Austrian news from Pola, and Italian news from Coltano. All the communiques and bulletins from the powers of the Entente are printed on yellow paper and those from the Central powers and their allies on blue paper. The bulletins are distributed to the press and to other subscribers three times per day, at meal hours.

ALL RADIO HEROES ARE NOT FOUND AT SEA.

In a recent number of the *American* magazine a wireless operator tells of the bravery of a radio operator in a shore station.

"Recently a terrific storm was raging along the coast. The Marconi operator at the Astoria, Oregon station, realized that he was apt to be killed at his post by lightning at any moment.

"Did he go away from his post because of his danger? Needless to say, no. The sea was breaking heavily and a hurricane was blowing furiously. This operator was watching over the lives of those at sea that night. Finally lightning struck his aerial.

"The young man, by what seemed almost a miracle, suffered only a few severe burns. The telephone, telegraph, and power lines were completely burned out. Never yet has a wireless operator failed in his duty to humanity on land or sea.

"As the citation of the Astoria incident shows, not all radio heroes are found at sea."

Rotary Spark Gaps

In these days of radio telegraphy the use of rotary spark gaps has become very

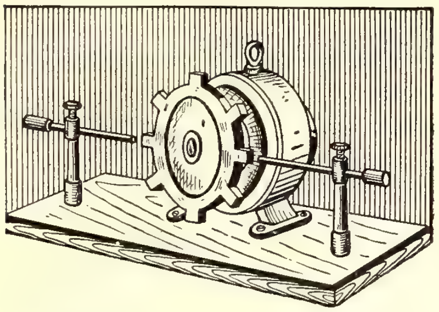


Fig. 1. First Form of Rotary Spark Gap Here Discussed.

extended. There are a great number of different type gaps on the market, some of them very efficient, and some of them inefficient. It is the purpose of this article to point out the advantages and disadvantages of a few of these rotary gaps, as shown by actual experiments.

TYPE 1.

This is the simplest form of rotary gap, and is more or less crude in design. It is operated by a small battery motor on four or more dry cells. As the principle of design is wrong, the results obtained with this gap are never very satisfactory. The spark obtained is very ragged and almost impossible to read, while the tone is low and unsteady. Fast and accurate transmission with it is an impossibility. By overloading the motor with batteries and thus running it at an excessive speed, the tone and spark are improved, but of course the excess current is liable to damage the motor. The trouble with the design is simply that the sparking points are too far apart for the revolutions of the motor.

TYPE 2.

This is similar in design to type 1, but of better design and more efficient. The sparking points are more numerous and the scallop effect in design gives a less abrupt break and consequently a steadier spark. The increased number of sparking points also gives a higher tone than type 1. A well-designed motor runs this rotary gap and it will operate on 110 volts d.c. or a.c. The gap can be used with good results up to about 1 k.w. While not recommended for long distance work, this gap is efficient and satisfactory for ordinary use.

TYPE 3.

This is a very good type of rotary gap, well designed and very efficient. In method of operation it is very similar to type 2, but is of improved design. It permits of very close adjusting of the electrodes to produce a clear spark, and the

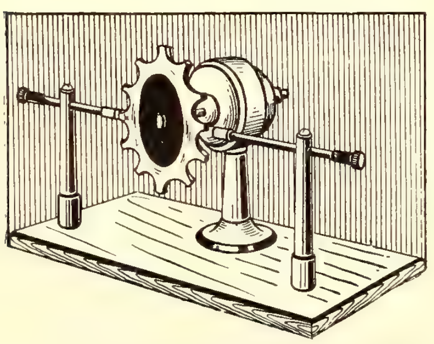


Fig. 2. The Scallop Effect Gives a Less Abrupt Break in Sparking.

high speed a.c. motor gives a very clear tone. It is very efficient for long distance work and operates successfully on powers up to 1 k.w.

TYPE 4.

This is without question the most efficient and satisfactory rotary spark gap in use in modern radio telegraphy. The motor is of exceptional design and is furnished for 60 cycles or any other frequency at any voltage. The gap consists of two rotary quenched spark gaps in series, formed by two semi-circular stationary electrodes placed in front of the circular rotating electrodes, the spark occurring between one stationary and one rotating electrode, and thence to the remaining stationary electrode. The faces of the electrodes have slots milled in their surfaces, leaving radial projections from which sparking ensues, at the rate of 25,000 condenser discharges per second. The radial projections

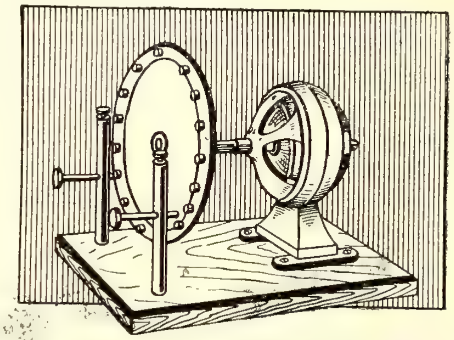


Fig. 3. One of the Simplest Yet Most Efficient Rotary Spark Gaps.

are used simply to break these discharges into groups corresponding to the tone desired from the set, as the discharge rate is so high that it approaches the limits of audibility. It will be seen that by varying the speed of rotation and thus the rate at which the sectors pass, any desired tone is produced. The efficiency of a transmitting set with a rotary gap of this design is from 60 to 70 per cent., which is very good. The tone produced is very high and

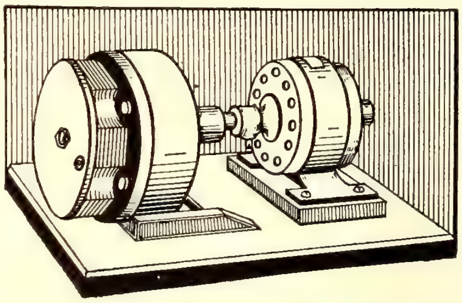


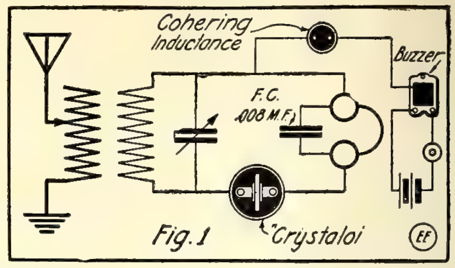
Fig. 4. The Rotary Quenched Gap Is the Most Efficient Type Ever Brought Out, Giving a Hy-Note on Low Frequency A. C.

piercing, resembling a clear whistle, easily read through static or interference, and is readily distinguished when used for long distance work.

SOME HINTS ON THE CRYSTALOI DETECTOR.

I have found out in the two years during which the Crystaloi detector has been on the market many things that are not embodied in the directions accompanying it. These things I have discovered by constant experiments in trying to gain improved results.

To begin with I learned that one hundred feet of No. 26 S.S.C. copper magnet wire wound on most any size tube and inserted in the *buzzer test circuit* as shown in hook-up Fig. 1, would cohere the alloy more closely, reduce the internal resistance and cause the detector to be much more sensitive. This *cohering inductance* appears to cause the finely divided alloy particles to become slightly "welded" to the sensitive mineral which the instrument contains. The "welding" of this alloy

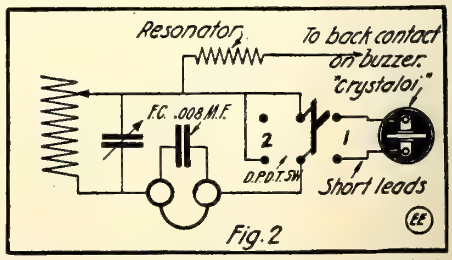


Best Hook-Up for the Crystaloi Detector, with Buzzer Test Connections and Condenser Value.

causes the detector to keep its adjustment to a marked degree. This cohering inductance is needed only with the type O, the larger types having it incorporated in the instruments. It has also been found through actual tests that a stopping condenser shunted across the 'phones and having a capacity of .008 M.F. makes a vast difference in the way of improvement. Condensers of lesser capacity are not nearly so efficient. It is absolutely necessary to employ a buzzer with the Crystaloi.

Variable condensers, no matter where used, should be set at zero when bringing the detector in, otherwise one will have difficulty in adjusting it. It is also necessary to have about one half of the inductance of the secondary circuit in use when setting the detector to maximum sensitivity. The primary inductance does not matter. In practice I find it better after one has secured a very sensitive position, to turn the cylinder in the opposite direction about one quarter of a turn. This also assists in maintaining permanent adjustment.

Many amateurs complain that the Crystaloi detector loses its adjustment when the transmitting apparatus is in use. This difficulty I experienced myself and after a long series of experiments I found the reason for this was due to the fact that any wire left connected to the detector, while transmitting, acted as a miniature aerial. This would pick up the waves from the transmitter and pass them through the detector, thereby destroying the adjustment by burning off the points of alloy in contact with the mineral and sometimes it would even destroy the mineral entirely, thereby causing the detector to lose its sensitivity. To obviate this I arranged a D.P.D.T. switch in the secondary circuit of the receiving set in the manner shown in hook-up at Fig. 2. When transmitting, the switch should be thrown to the position marked 2. This cuts out the detector entirely and closes the secondary circuit, so as to form a path for the stray oscillations that would otherwise enter into the detector circuit. *The short-circuiting of any detector, while sending, is about*



Method of Connecting D. P. D. T. Switch to Protect Crystaloi Detector While Transmitting.

the worst thing one can do, as it provides a complete path through the detector for all stray currents.

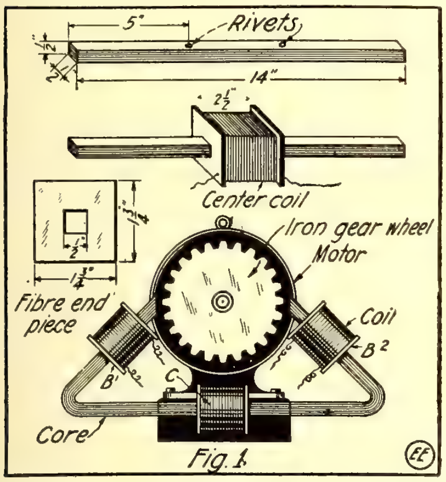
Contributed by ERNEY T. TUGENE.

THE CONSTRUCTOR

An Inexpensive High-Frequency Alternator for Testing Crystal Detectors

By Raymond Francis Yates

DOT-dash-dash-dash-dot . . . 000000000. "Curses! There goes that detector and Sayville sending baseball returns! Curses and more curses! Now the buzzer test is 'on the bum.' Say, Bill, can't we overcome this trouble some way? This is the third time that junk of a buzzer has failed. I'd give ten dollars for a good testing outfit that would be reliable."



Design for Small High-frequency Alternator Suitable for Testing Radio Detectors and Other Work.

"I 'doped out' a corking good idea the other day, Jim, on a testing outfit using a small high-frequency alternator in place of a buzzer."

"That sounds good, Bill, let's try it."

The proper adjustment of crystal detectors by the utilization of a buzzer is very unsatisfactory in many ways. If the current from the buzzer is too strong it will tend to "burn" the surface of the mineral and thereby reduce its sensitiveness. Aside from this the adjustment of the tone of the buzzer is difficult to maintain and many times fails to function at a critical time.

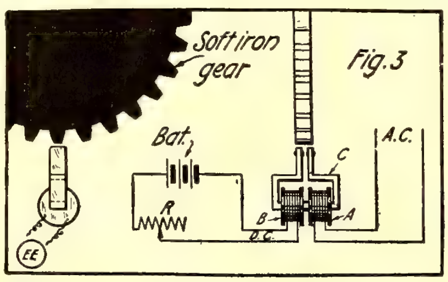
The high-frequency buzzers on the market are quite expensive and in many cases do not perform any better than an ordinary buzzer when it is adjusted to a high note.

The following description will enable any amateur, who is possessed of a small, high-speed battery motor, to construct an apparatus that has many advantages over a buzzer of any type. It is a high-frequency alternator of the most simple design and which will generate a current that is perfectly flexible both in frequency and volume. The delivered current can be changed from 500 cycles to a frequency that is far beyond audibility by merely changing the speed of the motor used by means of a small rheostat. The value of this apparatus, in the adjustment of crystal detectors, will readily be realized.

First, obtain a small iron gear-wheel of about 2½ inches in diameter and take it to a blacksmith shop and have it annealed. After the wheel is thoroughly annealed, fasten it to the end of a small, high-speed battery motor so it will run true. If the hole in the center of the gear-wheel is too large for the shaft of the motor, it can be plugged up with a brass plug and redrilled to fit. Next, cut enough transformer sheet iron 14 inches long to build up a pile ½ inch square. Rivet these together in two places as shown. Exactly in the center of this core wind a coil consisting of about 100 turns of No. 20 S.C.C. copper magnet wire. Fibre end pieces are cut as shown and used to keep the wire in place. Six of these will be needed. Now place the core in a vise and bend up the ends as shown in the sketch. This can be done with a mallet. Then put in two more rivets to prevent the ends from spreading. Slip the fibre ends over the core and wind coils B^1 and B^2, on each end of the core. Each coil consists of 100 turns of No. 22 S.C.C. magnet wire. A few inches is left on each end of the wire. Cover all the coils with linen tape and a coat of shellac. Provide the motor with a neat oak base and connect up four binding posts as shown. Mount the core on the base so that its poles will come as close as possible to the gear-wheel. This can best be done by filing the ends with a suitable half-round file. The apparatus is now ready for use and is connected as shown.

Referring to the diagram, it will readily be seen that by exciting the coil C a current will be induced in the coils B^1 and B^2. If the gear-wheel is revolving between the poles of the core, each tooth will alternately be a north and south pole and an alternating current will be set up in the circuit containing the coils B^1 and B^2. The frequency will depend on the speed of the motor and the quantity will depend upon the amount of current flowing in the circuit containing the coil C. The alternating current from the coils B^1 and B^2 is led directly to a small inductance coil that is placed in proximity to the ground wire, thus inducing a high-frequency current therein by induction.

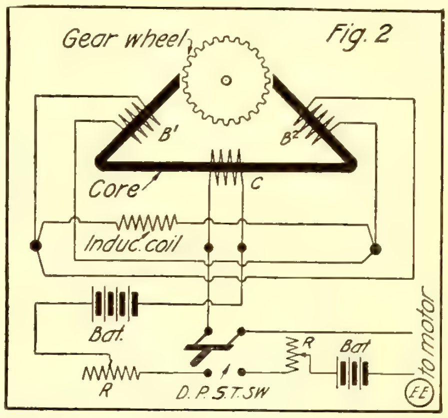
By studying the wiring diagram it will be seen that the D.P.S.T. switch is used both to close the motor circuit and also the exciting circuit of the coil C. The



Simple Form of High-frequency Alternator Comprising Two Coils on a Laminated Iron Core, Mounted Before a Revolving Gear Wheel.

coils B^1 and B^2 form an independent circuit which is directly connected to the small inductance coil near the ground wire.

[It is usually preferable to have the field pole-face pitch equal to the width of the gear tooth. An optional scheme for constructing a small high frequency alternator is illustrated at Fig. 3. The two coils A and B may correspond in turns to those



Connections of Stationary Coils of Alternator, Including Excitation Control Circuits.

cited above, using wire several sizes smaller. The coils are wound on the laminated (sheet iron strip) core C,, the pole shoes of which are bent after the coils are in place. One coil magnetizes the core as becomes evident. The other coil has alternating currents induced in it and is connected up in the same manner as indicated at Fig. 2.—Editorial Note.]

AN INTERESTING HINT FOR COIL USERS.

Beginners in electrical science often experience a difficulty in understanding the character of the current supplied by the secondary winding of an induction coil. While it is generally known that the induced current is alternating—flowing first in one direction and then in the opposite—a difficulty arises in connection with the polarity of the secondary terminals. The coil is connected with a geissler vacuum tube, let us say, and it is observed that the results are different when the polarity of the tube is charged. How is the student to reconcile the two facts? With an alternating current one naturally expects the polarity to reverse with each pulsation. The explanation is very simple. While the current induced in the secondary winding of a coil is certainly of an alternating character it is stronger in one direction than in the other. The highly attenuated gas which remains in a vacuum tube offers a considerable obstacle to the passage of electricity, an obstacle too great to be surmounted by the weak current but one that the more powerful current in the opposite direction is able to overcome. Hence the tube is traversed by the induced current in one direction only, thus accounting for the fixed polarity as evidenced by the characteristic glow at each end.

Contributed by H. J. GRAY.

A New Design for a Chromic Acid Battery

By C. A. Oldroyd

THE chromic acid battery is by far the best to use where a heavy current is required. The usual objection, however, is that this battery is rather "messy" and troublesome as the zincs have to be removed when not in use and the electrodes are difficult to clean.

It is, furthermore, a well-known fact that the chromic acid solution quickly loses its depolarizing power if it is not kept in motion. Thus the same solution if kept circulating through the battery, will keep the current at a much higher point than if the liquid was at rest. The following will show the experimenter how to make a simple circulation battery, furnishing a current almost as steady as that of a storage battery.

In the design described below these difficulties have been overcome and the battery will be as simple to use as a storage battery.

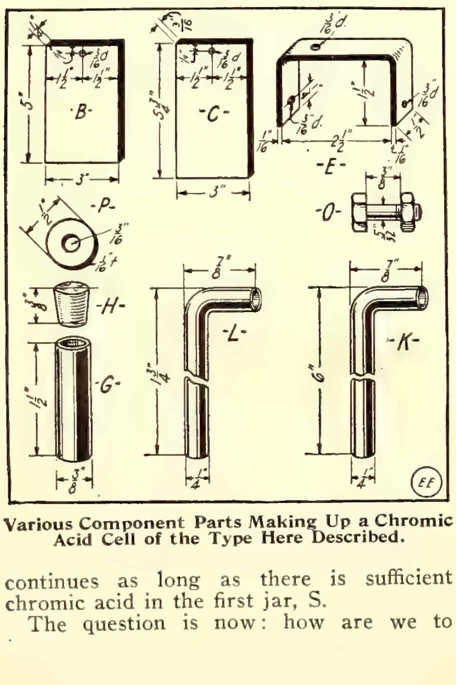
The battery consists of a glass jar, A, containing two carbon electrodes, B, and a zinc electrode, C, between them. The two carbon electrodes are connected by means of the copper strip E which carries a binding post, F.

The zinc electrode also has a binding post, I. The carbon and zinc electrodes are held in position by the black wax, D, which was cast into the jar. Two small glass tubes, M and N, penetrate the black wax and it will be seen that one tube, M, ends just below the wax, while the other tube, N, reaches down to the bottom of the vessel.

These glass tubes, M and N, permit the chromic acid to circulate through the battery.

This is accomplished in the following manner.

The diagram shows a number of batteries joined up; in this case six batteries. All tubes, M and N, have been connected with each other; that means M of one battery with N of the next and so on. The chromic acid is contained in a big glass jar, S, and brought into the first battery by means of a syphon, T, made from a glass tube and some rubber tubing. As the glass jar, S, is about 2 to 3 feet above the inlet the chromic acid will pass through the series of batteries forced by the head of fluid. After leaving the last battery of the series it passes through some rubber tubing and glass tube, Y, into a second glass jar, R, which serves as a receiver. This continues as long as there is sufficient chromic acid in the first jar, S.



Various Component Parts Making Up a Chromic Acid Cell of the Type Here Described.

The question is now: how are we to bring the chromic acid back to the first jar, S?

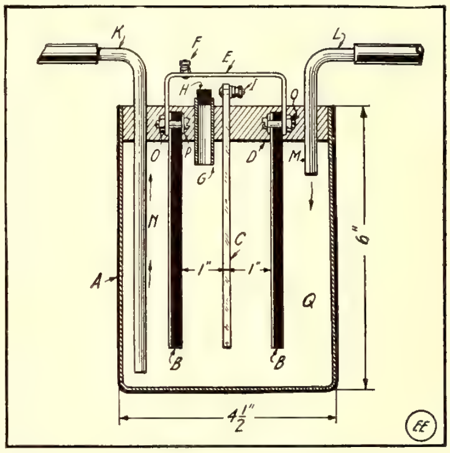
This is done by connecting the two jars by tubing and two glass tubes, L and V, and by forcing air into R by means of a small cycle pump, W, which is connected to R by a glass tube, X, and a short length of rubber tubing.

The drain from the last battery is temporarily closed by means of a pinchcock, which was slipped over the rubber tube. A few strokes of the pump will be sufficient to create a slight pressure inside R and force the chromic acid back into S by way of L, the rubber tubing and V.

After this, we start the syphon again by closing the tube, U, which passes just through the cork stopper and enables the outside air to enter S for a moment and a few strokes of the pump, W, will be sufficient to force the acid up the tube T. We open now U again and the chromic acid will take its old course through the batteries into the receiver jar, R.

As seen from the foregoing it is not at all necessary to come into contact with the acid, yes it is even impossible.

To clean the batteries after use we simply connect the inlet of the first jar to the water main and the outlet of the last jar to the drain and pass a stream of water through the batteries which will leave them in first class condition till they are used again. Thus no zinc can be used up while battery stands idle. The construction of the battery will now be described in detail. Most of the parts are standard and can be easily procured from electrical stores catering to the experimenter.

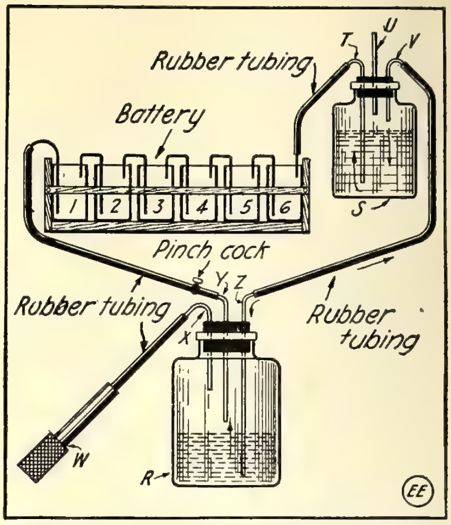

Detailed View of Assembled Chromic Acid Battery Cell with Carbon and Zinc Electrodes in Place.

The carbon and zinc electrodes should be procured first. The carbon electrodes measure 3 inch by 5 inch and are ¼ inch thick. A hole 3/16-inch diameter is then drilled ¼ inch from the end to take the screw O. The zinc plates measure 3 inches by 5¾ inches and are 3/16 inch thick. A hole 3/16 inch is drilled through the zinc plates similar to the carbon electrodes. The connecting strip, E, is made from copper strip ½ inch wide by 1/16 inch thick and bent to the dimensions given. Three holes 3/16-inch diameter are drilled in the positions shown, two of them to take the screws O and one on top to take a binding post, F. The screws, O, and copper washers, P, can be bought from electrical stores.

The carbon electrodes, B, and connecting strip, E, can now be assembled.

We turn next to the glass tube, G. This is ⅜ inch in diameter and 1½ inches long, and has a stopper, H, which fits it tightly. This glass tube should be closed when working, it is only used to dry the batteries after cleaning by removing the stopper.

The glass tubes, M and N, are made from tubing ¼ inch in diameter and are bent as shown.



Showing How Several Chromic Acid Cells Are Connected Up so as to Permit of Readily Circulating the Electrolyte thru Them with a Bicycle Pump.

These tubes can be bent easily in the flame of a Bunsen burner.

The carbon and zinc electrodes and tubes must now be cast into place.

The easiest way of doing this is to cut a board which fits over the glass jar and has a few slots and holes to hold the plates and tubes in the position required; also another big hole to allow the black wax to be poured in. We place the board with the plates and tubes over the jar, A, and fill the jar with water up to ¾ inch from the top. After having dried the inside of the jar (this is important) above the water we pour a thin film of molten paraffin wax about ⅛ inch thick on top of the water and upon this molten black wax such as used for sealing accumulators till flush with the top of the jar, A.

The battery is now completed and we drain the water out of A through the glass tube, M.

After the number of batteries required have been made we assemble them in a wooden box and connect the tube, M, of one jar to the tube N, of the next one by means of rubber tubing, K and L.

Two five-gallon jars, R and S, are next required and fitted with cork stoppers treated with molten paraffin wax to make them acid proof. The glass tubes, T, U, V, X, Y and Z, are made from tubing ¼ inch diameter and bent to suit position of jars. The jar, S, should be placed 2 to 3 feet above the battery and R about one foot below. We connect finally the cycle hand pump, W, to the tube, X, and our battery is complete

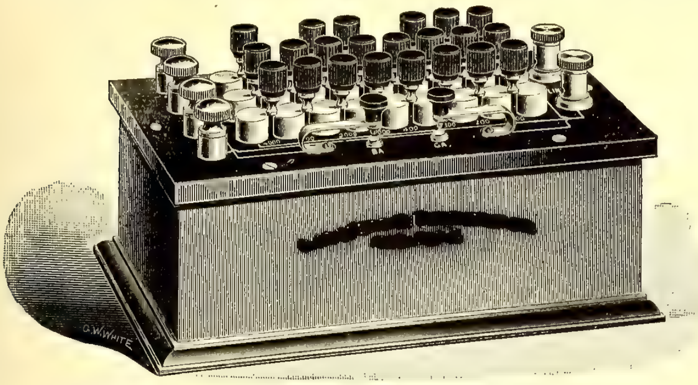
The best solution for use in this type of battery is prepared as follows: 7½ parts of Bichromate of Sodium, 15 parts of concentrated sulphuric acid mixed with 200 parts of water.

This battery has a voltage of 2 volts per cell and gives a current of about 20 amperes; it is, therefore, very suitable for running spark coils and motors from it, in fact for all experiments which require a large current.

It should be understood that after a certain time the chromic acid loses its depolarizing power (as evidenced by the decrease of current generated); then the liquid must circulate farther and farther until exhausted entirely.

Construction of a Wheatstone Bridge for Measuring Resistances

The following is a brief description of a simple, yet comparatively accurate Wheatstone bridge that the Experimenter will find to be useful in many ways.

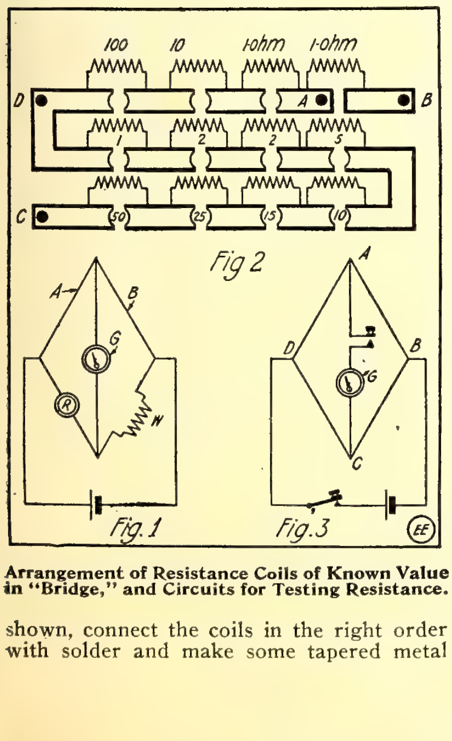


Commercial Form of Wheatstone Bridge for Measuring Resistance Similar to the Type Here Described.

The materials required are easily procurable at but little expense. First secure half a pound of No. 30 S. C. C. copper magnet wire, and if possible borrow a calibrated bridge and measure off lengths of wire of 1, 1, 1, 2, 2, 5, 10, 10, 15, 25, 50, and 100 ohms resistance. If unable to secure the bridge take some instrument of known resistance such as a Bell telephone receiver (75 ohms) and find by trial a length of the No. 30 wire whose resistance is exactly equal to the receiver.

This may be done by using a hook-up as indicated in Fig. 1, where A and B are equal lengths of wire, R the receiver, W the wire whose resistance is to be exactly equal that of the receiver, and G a galvanometer. When the galvanometer needle remains exactly in the center the two resistances are equal. Do not leave the battery connected directly in the circuit but connect it just long enough to take a reading of the needle deflection. Measure the length of the wire carefully and from this information cut off the required lengths. A somewhat less accurate instrument can be made by using the approximate resistance value of 1 ohm per 9.686 feet of wire.

Having made up these resistance coils, secure three strips of ¾ x ⅛ inch brass, 7½ inches long to be drilled and cut as shown in Fig. 2. Place binding posts as



Arrangement of Resistance Coils of Known Value in "Bridge," and Circuits for Testing Resistance.

shown, connect the coils in the right order with solder and make some tapered metal plugs to fit the holes. These plugs can be turned out of brass or can be made as described on page 38 of THE ELECTRICAL EXPERIMENTER for May, 1916. The galvanometer can be purchased or may be constructed after any of the designs as described in previous issues of this journal.

To measure the resistance of any coil, wire, etc., connect it across the binding posts C and B (Figs 2 and 3) and with a plug out of the ratio coils (that portion included between posts D and B), remove enough plugs from the resistance coils to equal what you judge the unknown resistance to be. Then press *first the battery key and then the galvanometer key* (always in this order), noting the amount and direction of deflection of the galvanometer needle. By removing or replacing plugs, vary the resistance until upon pressing the keys the galvanometer needle remains in the center. Add up the resistances indicated by the removed plugs and from this and the ratio in the ratio coils the unknown resistance can be determined. If the ratio coils were set at 1 to 1 and 28 ohms resistance was in circuit the unknown resistance would then be 28 ohms. If the ratio was, say 1 to 10, the resistance would be 280, and if 1 to 100 it would be 2,800 ohms. In this way resistances up to 11,000 ohms can be measured.

Be sure the plugs are secure in their sockets, as loose plugs increase the resistance, giving rise to errors. Also do not handle the plugs, as a little grease from the hands will increase the resistance and lower the accuracy of the instrument. If properly constructed this instrument can be made to measure resistances with a very slight error; surely within the limits required in the calculation of any ordinary circuits.

The instrument can be mounted in any suitable box preferably with the brass plates screwed to the top, and the galvanometer face projecting, or separate, as desired.

A NOVEL TELEPHONE RECEIVER.

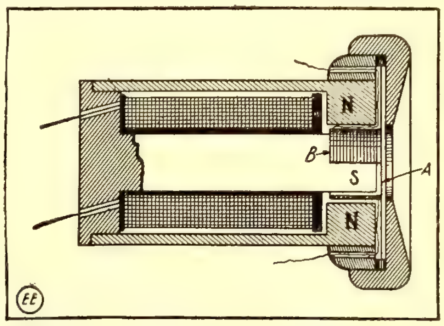
For some time past there has been considerable development in magnifying the sound from receivers using some sort of moving iron armature, but little has been done toward applying other, yet possibly better principles. A definite amount of electrical energy entering a receiver cannot produce quite that amount of mechanical power in the form of sound, yet the ordinary receiver has been made more sensitive by the addition of mechanical levers and light diaphragms. This shows that the efficiency could not have been very high in the first place, and if the mechanism could be simplified a still higher efficiency should be expected.

The following description of a new receiver, using an old principle, should prove of interest in wireless work, especially where low voltage circuits are to be used.

On the lower side of a thin mica diaphragm (A) is mounted a coil of fine wire (B) wound on a paper cylinder about ⅝ inch in diameter and about ⅜ inch long.

This moving element is mounted so that the coil will be free to vibrate up and down the cylindrical air gap between the poles of a permanent or electric magnet, one pole of which is the end of a round rod (S) extending up into the paper cylinder, and the other pole (N) completely surrounding the outside of the paper cylinder. Two leads from the moving coil connect with the radio receiving or telephone circuit.

The only losses this receiver can have apparently are molecular friction in the diaphragm and air and the electrical resistance of the receiving coil. There is no hysteresis loss, and practically no eddy currents. Although a very small current would move the diaphragm when the coil is working in a strong field, it would not operate so rapidly as when in a weaker field. In its simplified form only a small amount of wire can be used in the moving coil. A receiver like the one here described having about 36 ohms of No. 40 enameled wire on the moving coil was built and found to be very sensitive, but as there were no delicate instruments at hand, a thorough test could not be made. It is worthy of further experimentation.

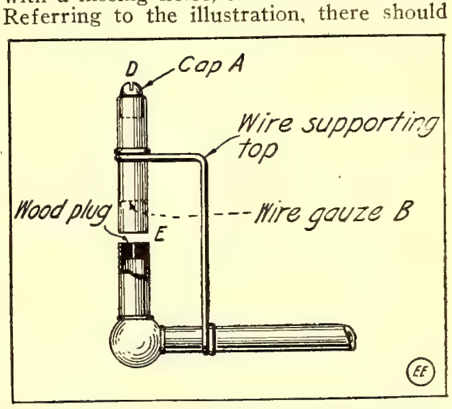


A Moving Coil Telephone Receiver Having a Magnetizing Coil for Polarizing the Iron Frame.

Contributed by A. J. WILLAT.

GAS HEATER FOR SOLDERING IRON.

Having need for a heater for a soldering iron, the writer made a cheap Bunsen burner in the following way: Unscrew the end of the gas jet and remove the tip A and the wire gauze B inside. As the principle of the Bunsen burner is the mixture of the gas with air before ignition, an opening must be made to admit air. This is done by raising the pipe about 1/16 inch above the rest of the jet. As the hole in the jet is too large for sufficient gas pressure, this can be made smaller by putting in a wood plug and piercing it with a small hole. The flame then generated at D should be blue, with a slight tinge of white at the top. If the flame should burn with a hissing noise, the hole is too small. Referring to the illustration, there should not be any flame at E, only at D. If the opening at E becomes too large, the burner will flare back and a flame will appear at that point.



A Bunsen Burner Made from Ordinary Gas Jet.

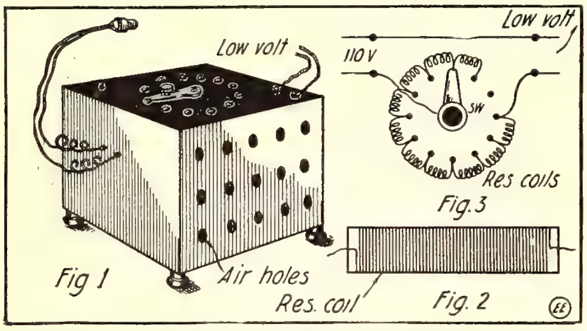
This burner will be found very suitable for heating a soldering iron.

Contributed by T. O. WOHLSEN.

A Rheostat for 110 Volts

Following are the details for the construction of a rheostat or current reducer, which if built with care will be found to be absolutely safe and efficient and which will provide current for practically all low-voltage apparatus. It can be used satisfactorily on either alternating current or direct current circuits.

The necessary materials are: One box 7x5x4.5 inches (preferably metal with wood or slate top), 100 feet of No. 26 bare Nichrome resistance wire, one broomstick, one square yard of heavy asbestos sheeting, one miniature switch lever, 12 contact points, four binding posts, two dry-cell binding posts, several tacks, a short piece of insulated wire, one attachment plug and eight feet of lamp cord.



Details for Constructing a 110 Volt Coil Type Rheostat. The Same Idea Is Applicable to Larger Size Units, or for Different Voltage Connections.

Line the box with two or three layers of asbestos sheeting. Then invert it and in the exact center fasten the switch lever. Arrange the contact points in a circle around it. Mount the four posts as indicated in the figure. With insulated wire connect as shown in diagram, Fig. 3. (The wiring is on the inside of the box, of course.)

The resistance units are now to be constructed. Saw four pieces from the broomstick, each 6.5 inches long. Cover these with three or four layers of asbestos sheeting, holding the layers in place by a tack partially driven in at each end. Wind several turns of the resistance wire around one of these tacks and then proceed very carefully to wind the coil. About 80 turns can be taken without toucing one another. This will be about 25 feet. Wind the wire several times around the other tack and then drive both in. This will hold the wire secure. Construct three other coils in exactly the same way. In the middle of one of the coils loosen a turn and fasten a piece of insulated wire to it. With the other coils, however, an insulated wire is fastened 1-3 of the way from one end and another is fastened 1-3 of the way from the other end. This is the only way in which one of the coils differs from the others.

Fit the coil (with a wire leading from the middle) in a lower corner of the box. Drive a tack into each end to hold it secure. Then connect the wire at one end of it to the dry-cell post to which only the lamp cord is connected. Then fasten the insulated wire in the middle of the coil to the contact point numbered 1. Fasten the wire at the end of the coil to contact 2. Fit in another coil. Connect one of the end wires to the end wire of the other cell which was fastened to contact 2. Then proceed in the same way as was done with the first coil, fastening the insulated wire 1-3 of the way from that end to contact 3, and so on. When the four coils are installed, an amperage ranging from 4 to ½ can be drawn, the highest from contact 1 and the lowest from contact 11, contact 12 being neutral. Fasten the lid on, then bore several holes in different places in the box for ventilation. A coat of varnish will greatly enhance the appearance of the instrument. A drawer-pull can be fastened on one end for convenience in carrying.

The wide range of current will be sufficient for nearly all apparatus. It should be stated, however, that small 2 to 3 volt Mazda lamps will burn out if used on this rheostat. Regular 14-volt bulbs (the same as used for headlights on miniature locomotives) should be used.

Should the experimenter have but little use for the 4-ampere current, No. 30 B. & S. Nichrome wire will be very satisfactory. If this size is used, only 35 feet will be necessary. However, if the 4-ampere current is to be used for long periods it will be best to wrap asbestos sheeting on the coils. The ventilation holes should be enlarged also. For the safest operation the rheostat should be made entirely of slate and metal (tin of black stovepipe iron riveted or soldered). Also, it should rest on four porcelain knobs.

Eighteen per cent. or 30 per cent. German silver wire may be used instead of Nichrome wire. If 18 per cent. wire is used 300 feet will be necessary; if 30 per cent. wire is used 200 feet will suffice. Any other wire with a resistance of one ohm or over per foot may be used. However, it is best to use the Nichrome wire if it can be obtained.

The rheostat described above will not heat up excessively if used for ordinary periods.

DIRECTIONS FOR REFILLING GRAVITY CELLS.

1. Draw off the greater portion of the zinc sulphate solution in the old cell by means of a syringe.
2. Remove the zinc and clean ready for use again if sufficient remains.
3. Throw out the copper sulphate solution and clean jar and copper electrode if deemed advisable. If not, throw electrode and crystals away and replace with new, as follows in recommendation No. 5.
4. After jar is cleaned, fill with water up to the lower edge of the zinc, leaving out water to the amount of zinc sulphate solution taken from old cell.
5. Open out the leaves of the copper electrode, place it in position in the bottom of the jar and cover with copper sulphate crystals of proper size (total weight approximately two pounds).
6. Pour in the water mentioned in recommendation No. 4 for old cell.
7. Very carefully pour the zinc sulphate solution mentioned in recommendation No. 1 for old cell, into the cell with as little disturbance as possible.
8. The terminals may be short-circuited until the *blue line* is established, after which the zinc may be removed and cleaned and upon being replaced, the cell will be found in good condition.
9. Add heavy paraffine oil to the surface to a depth of about 5/16 to ½ inch (about six ounces) to act as a seal against evaporation and creeping of zinc sulphate salts.

A HINT FOR RUBBER TUBE CONNECTIONS.

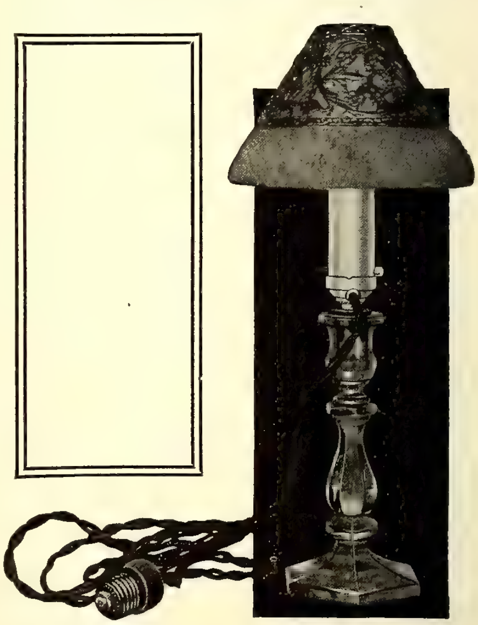
Rubber tubes are always liable to collapse and develop kinks, especially near the ends where they are connected to glass or other tubes. This can be prevented in a very simple manner. Select a rod a little smaller than the outside of the tube. Wind a length of brass wire round it to form a spiral about two inches long; slip this over the rubber tube so as to cover the part where kinks are most likely to occur.

Contributed by GEORGE LESLIE.

HOW TO MAKE ATTRACTIVE ELECTRIC CANDLES AND PORTABLE LAMPS.

Something new in the way of electric lamp sockets is known as the candle length socket because in place of the usual brass shell of the ordinary standard socket, a white fibre shell in the shape of a candle is employed. This socket can be supported on a glass or other solid candle stick, one of which is shown in the illustration. It is not necessary to do any wiring other than connecting up the lamp cord to the socket. These electric lamps are very pretty for use in the home, on the dining table, the dresser, or mantlepiece. In the position in which the socket is shown in the illustration it will be noted that there is an outlet in the side of the socket cap through which the cord passes. The parts such as the holder and shade can be purchased most any place or you may have them about the house, while the electric cord, lamp and the candle length socket may be secured at any electric shop. The same type of socket can be employed on ceiling and wall fixtures also. For such purposes the cap of the socket does not have the extra side outlet because the fixture wires enter from the fixture through the regular cap outlet.

Where a table or reading lamp is wanted, a new push socket is made which resembles the standard types except that it is arranged so that interior wiring of the fixture on which it is used is unnecessary. A solid wooden pedestal may be utilized, or a gas bracket or table lamp converted into an electric very easily. It is only necessary to secure the socket at the top and lead the lamp cord from this socket to any source of electric supply. The result is a serviceable, portable lamp, quickly and cheaply made. The operation is by means of push buttons, the pushing of the light colored button lighting the lamp and the depression of the black one extinguishing it.



Application of the New Candle Length Socket with Side Outlet Cap on Candle Stick

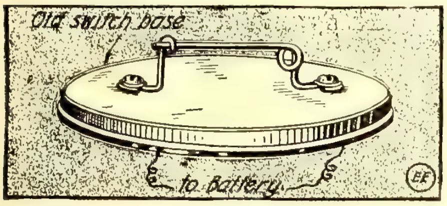
This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.

The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00

SIMPLY MADE BATTERY SWITCH.

With six inches of brass or steel spring wire and in as many minutes, one can make this emergency battery switch. Bend the two lengths of wire as shown in illustration and twist the one making contact two or three times around a nail so as



Extremely Simple Battery Switch Composed of Wood Base and Two Bent Wire Members as shown.

to give it more elasticity. An old battery base, properly drilled for the insertion of switch points, may be used if handy.

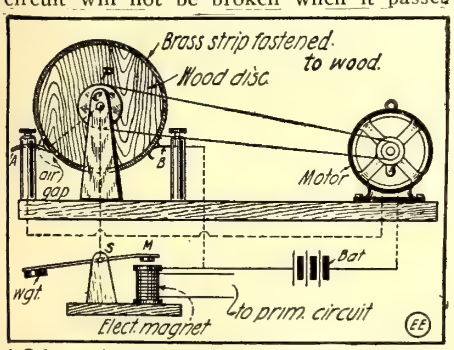
Contributed by JOHN T. DWYER.

ROTARY SWITCH.

It is often desired to operate a small motor to run a recording device by means of a secondary circuit. I show here a simple and effective method of control. The difficulty usually encountered is that of opening the secondary circuit at the end of a message when running a recording telegraph instrument, for example.

In the diagram shown, the motor is started by energizing the small magnet M in the primary circuit in series with the telegraph buzzer or relay. This closes the secondary circuit, starting the motor, causing the disc to rotate. Now when both brushes are on the long strip (see diagram) the circuit remains closed and the message may be sent. When the small segment comes to brush A, the circuit will automatically be opened unless the primary circuit is closed.

The advantage of this switch is that the apparatus is always "set" and never needs to be set at the receiving station. It will be noted that switch A is smaller than the segment, whereas brush B is larger than segment plus insulation gap, so that the circuit will not be broken when it passes



A Scheme Adapted to Operate a Small Motor to Run a Recording Device by a Secondary Circuit.

this brush.

Contributed by L. J. JACKSON.

THIRD PRIZE $1.00

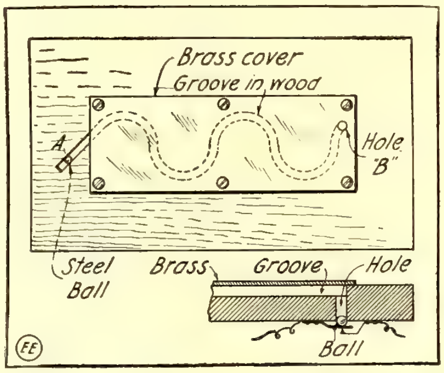
A SHORT CIRCUIT CLOSER.

Take a board 1x3x4 inches and on one side with a hot iron or penknife make a groove, as shown.

Bore a hole through the board in the end of the groove and mount two thin springs under the hole 1/16 inch apart, so that a steel ball dropped through the hole will close the circuit between the two contacts.

With screws or rivets fasten a thin brass cover over the design, leaving a short end "A" of the groove uncovered.

To operate, place a steel ball in the groove at "A" and with a steel magnet trace out the design over the brass cover.

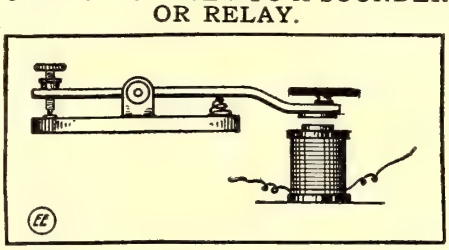


Place a Steel Ball in the Slot at "A," Coax it Along the Blind Groove to "B," where it Falls in Hole and Closes Lock Circuit.

The steel ball will follow the magnet and if the design is traced correctly, will fall in the hole "B" at the end of the trench, closing the circuit. A bell connected in series will be rung, or an electric lock operated. It will be impossible for the ball to follow the magnet if the design is not traced right. The scheme is susceptible of many other designs and details and will keep the "undesirables" out of your tool drawer.

Contributed by PAUL CALHOUN.

CHANGING A KEY TO A SOUNDER OR RELAY.



Making a Telegraph Sounder or Relay from Pair of Electro-Magnets and a Key.

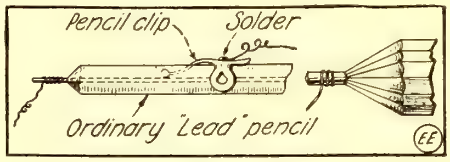
By screwing a small iron bar to the lever, and arranging two magnets below it, a key can be changed into a sounder or a relay. If used as a sounder, the key should be opened about one-eighth of an inch, but for relaying purposes the movement must be very slight.

Contributed by HAROLD RICE.

SECOND PRIZE $2.00

SIMPLE PENCIL RHEOSTAT.

In the June issue I noticed a contribution which was called the *Simplest Rheostat.* Without egotism, I am inclined to think that this idea of mine has something on it for simplicity, in so much as no materials other than the pencil and clip are required.



The Simplest Pencil Rheostat Made by Slotting the Wood and Fitting a Fountain Pen Clip to It.

All one need do is to saw or cut a groove in the middle of the pencil, as shown in Fig. large enough to enable the clip to make contact with the *lead rod* (it may not be amiss to state here that the *lead* in pencils is really graphite, an allotropic form of carbon, possessing high electrical resistance). One battery wire should be soldered to the clip and the other wound around the end of the rod.

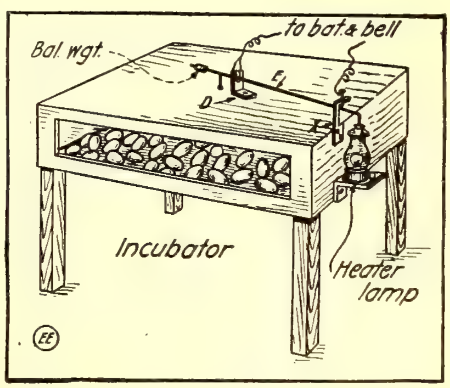
Contributed by JOHN T. DWYER.

ELECTRIC ALARM FOR INCUBATOR.

In this electric incubator alarm scheme one wire from the battery is connected to the fulcrum, D, of the rod on the thermostat if the rod is metal. The other wire from the battery goes to a switch, from there to the bell and then to the metal strip, bent as shown in the illustration at X with a contact screw in the top. This piece is first placed so that the arm makes contact with the bottom when too *cold.* Then the screw is adjusted so that it makes contact with arm E when too hot.

If the arm is made of wood instead of iron, a piece of tin or brass should be bent around the arm at X and a wire run from this to the fulcrum. One battery is usually sufficient

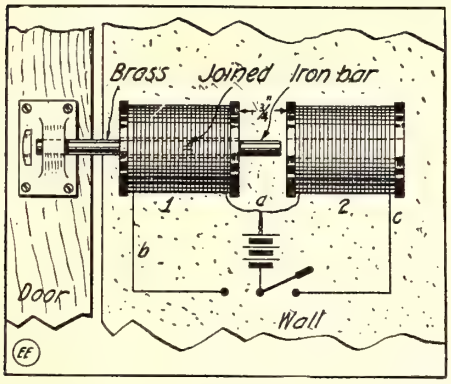
Contributed by DEWEY JOHNSTON.



Electric Alarm Attachment for Incubator Which Rings a Bell at Extreme Hot and Cold Points.

ELECTRIC DOOR LOCK WRINKLES.

Fig. 1 illustrates an electrically operated door bolt which may be constructed from two coils, 1 and 2, with their iron cores ex-



Simple Form of Magnetic Door Lock in which One Magnet or the Other Pulls the Iron Bolt Open or Shut.

tracted, a bar of brass with a short piece of iron attached to it, a few feet of wire, a set of batteries and a switch. Assemble as shown.

To operate, close switch to C and the bolt will slide to coil No. 2 and vice versa to close. Always leave the switch open after locking or releasing the bolt.

Contributed by ADOLPH ZULINKE.

RENOVATING WORN FILES.

The renovation of files can be easily done in this manner: Wash the files with soap, and brush well while washing. Then dip in a solution composed of nitric acid and water, equal parts of each, for about one hour and wash again.

Contributed by AURELIO SIERRA, JR., (Mexico).

A "SHOCK-PROOF" SWITCH INSULATOR.

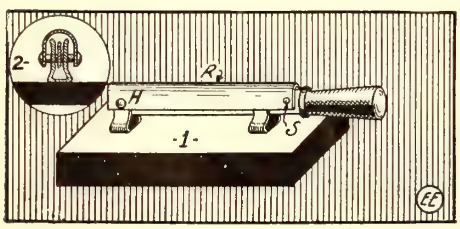
This simple but helpful device lessens the chances of getting a shock or being electrocuted when manipulating knife switches.

Procure a sheet of hard rubber about one-sixteenth of an inch in thickness, which is long enough and wide enough to cover the switch arm as shown in Fig. 1 and 2 at R. The rubber can be bent in the shape shown at R, Fig 1, by immersing it in boiling water, and bending it while hot. In this way the rubber insulates or covers the whole switch arm.

The hinge part of switch shown at H, Fig. 1, should be filed off round so as not to cut the rubber. Bore a small hole in the handle as shown at S, tap it if desired and insert a small screw, or a small bolt will do, with a nut fastened on the other side to retain the rubber.

These insulator guards can be used on a switch with any number of poles or arms, but only of the single throw type.

Contributed by
MELVILLE W. CRANE.



"Shock-Proof" Insulator for Knife Switches. It Is Made of Fibre.

TO MAKE IMITATION FROSTED GLASS.

A frosting mixture to be painted on the glass is composed of sandarac, 18 drams; mastic, 4 drams; ether, 24 ounces, benzine, 16 to 18 ounces. This application cannot be exposed to a high temperature.

Another source says to make frosted glass (imitation) paint the glass with saturated solution of Epsom salt, to which a very little mucilage of acacia has been added.

SOME USEFUL ELECTRICAL WRINKLES.

Herewith are a few ideas which I thought might be of interest to experimenters.

No. 1, is a method I use for twisting wires, such as annunciator wires. It may also be used to unwind them. To wind a cable cut the wires the length desired and fasten to hooks H_1 and HH screwed on a wood stick S. A is a

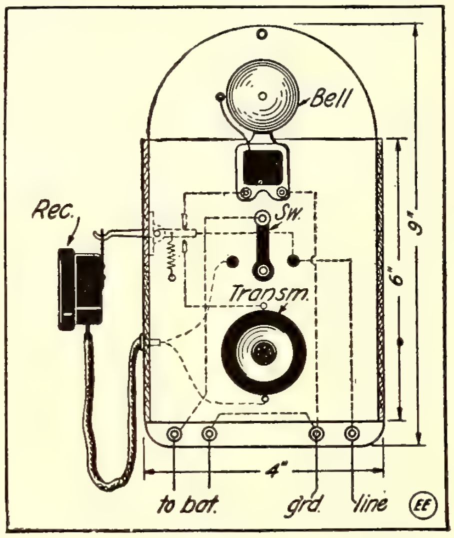
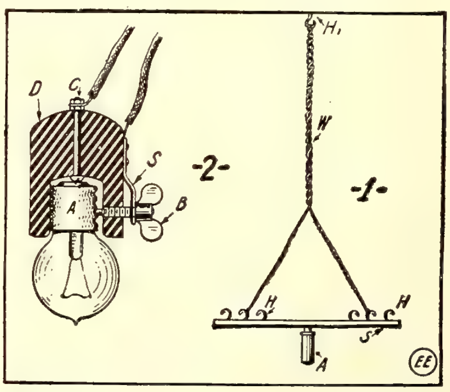


Fig. 3. Telephone Made from Various Standard Parts at Slight Expense.

handle for holding the stick with wires attached. As the winding proceeds, move the wires nearer the center for winding, and farther from the center to unwind.

No. 2, is a miniature lamp socket; D is made of wood, fibre or hard rubber. C is a small screw to make connection, S is a spring which bears against B, a screw from a battery zinc; S is held to D by means of two wood screws.

No. 3 is a telephone set which I constructed from odd parts. As the wir-



Figs. 1 and 2. A Scheme for Twisting Telephone Cables and a Simple Lamp Socket.

ing and connections explain themselves they need no description.

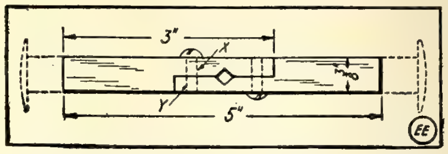
The operation is briefly as follows: The switch normally remains open and hook is closed. When it is desired to call, the switch is moved on right contact a number of times. Then the receiver is taken off the hook which connects the talking circuits when SW is moved from right to left. After the receiver is replaced on hook, switch must not be on either point.

Contributed by W. E. LEACH.

A FIVE-CENT TAP-WRENCH.

Herewith are the directions for the construction of a small tap-wrench, which if home made, should cost not over five cents:

Secure two bolts 4" long and ⅜" thick. Cut them off above the threads and also



Home-made Tap Wrench Constructed from Two Bolts. Drill Tap Holes with No. 29 Drill; Slip Holes with No. 26 Drill.

the top, leaving the rod 3" long. File them as shown in the illustration, tapping the holes marked "Y" and drilling the holes marked "X," so that the screw will fit loosely. Try to be accurate in drilling the holes as success in this case depends principally on this. The screws may be tightened with a screw-driver or knurled thumb-screws can be used if at hand. The square hole section can be case-hardened by heating the bolt ends to a cherry red, then plunging them into cyanide potassium.

Contributed by ELMER E. FANCHER.

USEFUL EVERYDAY HINTS.

No. 1—Few people know this never-failing method for unscrewing a fountain-pen which has stuck for any reason. It can be unscrewed in a second, if a rubber band is wrapped around the end, thus allowing a firm grip to be obtained. It will be found that it will turn very easily, when other methods have failed.

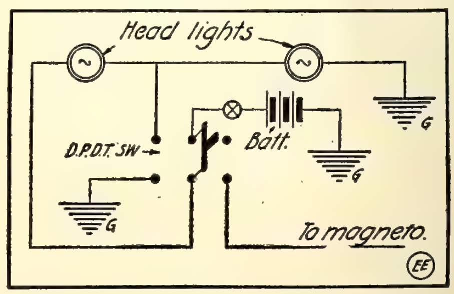
No. 2—How to Make a Casting—For making the mold to cast small articles of zinc, lead, and other soft metals, mix equal parts of sand and plaster of Paris. Allow the mold to set thoroughly and dry it in an oven, for if there is any moisture left, the casting will be spongy or blistered. For large articles, use ordinary moulders' sand, and make it so damp that it will rapidly cohere, but will not stick to the fingers. Dust over the pattern, and along the junctions of the sand, with finely powdered rosin or burnt sand.

No. 3—To drill glass, keep the drill freely lubricated with camphor, dissolved in turpentine.

Contributed by ALFRED H. HUST.

BATTERY CONNECTION FOR FORD CARS.

Ford cars running very slow or coasting down a hill have little or no light to guide them. By using this connection any owner can use either his magneto, by throwing the D.P.D.T. switch to the right, or the battery by throwing the switch to the left. A storage battery, of course, should be used. A rheostat (X) may be inserted between the bat-



Switching Scheme for Ford Cars, Enabling One to Throw Lights on Magneto or Battery.

tery and switch to dim your lights when approaching another car.

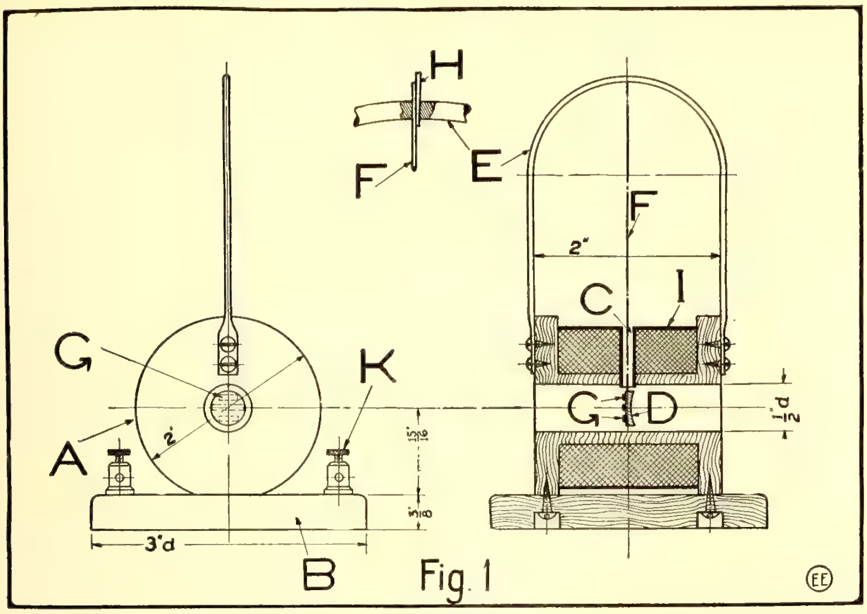
Contributed by G. T. MORGAN.

How to Build a Highly Sensitive Galvanometer

By C. A. Oldroyd

The instrument described here is very sensitive and when carefully made will respond to the following test;

The mirror "D" has 3 small magnets, "G", made from a magnetized watch spring, glued to its back.



End and Sectional View of Reflecting Mirror Galvanometer. One of the Most Sensitive Instruments of the Kind Available. Invaluable for Measuring Extremely Weak Currents.

Take a sewing needle and an ordinary pin and connect them to the instrument. Immerse both needles into a drop of salt water and the galvanometer will indicate a current generated by this tiny battery of two needles and a drop of salt water.

In Fig. 1 "A" is a wooden bobbin turned to the dimensions shown and with a ½-inch diameter hole in the center. One side is then cut flat as shown to permit screwing it to the baseboard "B".

"C" is a short glass tube ⅛-inch diameter by ⅝-inch long, and is inserted in "A".

The bobbin "A" is wound with enameled wire about No. 36 or No. 38 B. & S. gauge, and the ends of the wire are connected to the binding posts "K".

"H" is a pin which serves to adjust the silk thread "F".

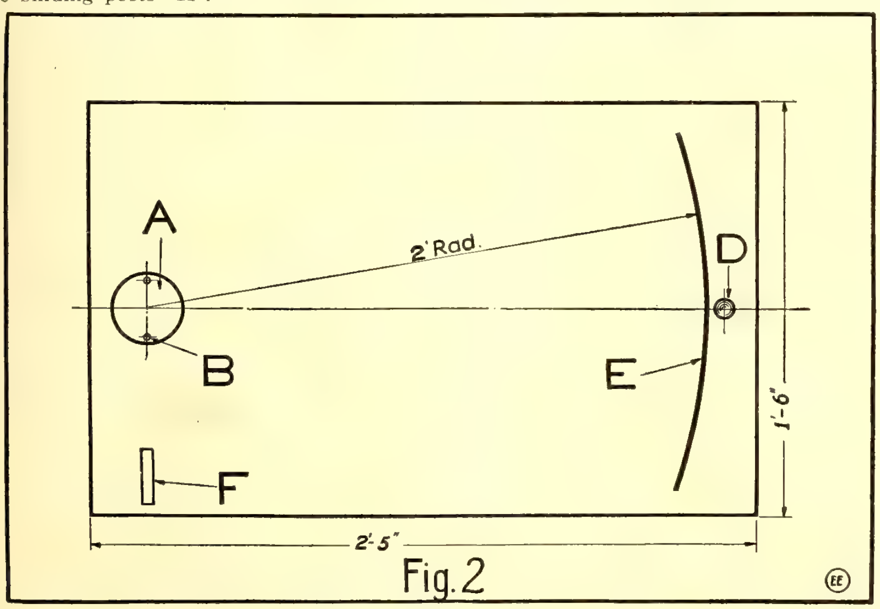
"I" is a sheet of thin black fibre to protect the enameled wire.

In building this instrument care must be taken to use brass screws only, as steel screws would affect its efficiency.

Figure 2 shows the galvanometer with its accessories.

"A" is the galvanometer with its binding posts "B". "C" is the baseboard 2 feet 5 inches long by 1 foot 6 inches wide.

"D" is a small electric lamp that throws its light upon the mirror of the galvanometer from where it is reflected to the scale "E" which is made from a brass strip about 1 foot 3 inches long bent to the arc shown. On this brass arc there is pasted a strip of drawing paper graduated in half inches or finer.



Plan View of Galvanometer with Zero Control Magnet F, Source of Light D and Graduated Scale E. Sometimes a Small Telescope is Placed Just Above D Thru Which to Observe the Moving Mirror and Scale Image

"D" is a small silvered mirror about 5/16-inch diameter, suspended from a bent brass wire "E" by means of a silk thread "F".

The lamp "D" must be above the scale and covered with a tube having only a small hole, say ⅛-inch diameter, on one side so that a narrow beam of light is reflected to the scale "E" by the mirror.

"F" is a small steel magnet to steady the mirror magnets. The best distance from "F" to the galvanometer must be found by experiment. It should be just close enough to exercise control over the moving element. If too close it will lower the sensitivity of the galvanometer. An oil lamp may be used instead of the electric bulb "D".

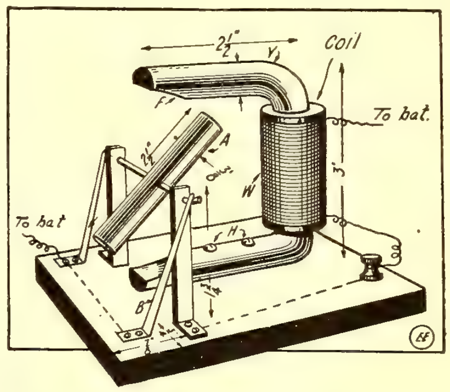
Every experimenter should own a sensitive galvanometer such as the one here described. The higher the resistance, the greater the sensibility of the instrument. *Shunts* may be placed across the terminals for strong currents.

A BATTERY MOTOR OF FEW PARTS.

The constructional details of a cheap and simple battery motor are shown in the drawing here. The material needed is listed below.

8" ⅜" soft iron rod
2½" ⅜" soft iron rod.
2 pieces brass 2½"x¼"x⅛"
8 small wood screws
2, ¾", 6-32 bolts
Base board 4"x4"x½"
2 pieces brass spring 2¼"x¼"
1 piece steel wire 3"xNo. 12
25 feet No. 20 S. C. C. magnet wire.

The longer piece of iron rod is bent as shown at Y, Fig. 1. The points F, F are filed away to present a larger pole face to the ends of the armature A, thus increasing the strength of the motor. One of the legs is filed down about ⅛" and two small holes H, H are drilled, through which ¾" machine screws are placed, which secure it to the base. This field member is mounted on the base centrally. The smaller piece has a hole bored through the center of it, through which the piece of No. 12 wire is passed, the rod being soldered to it at the center. The details of the bearings and brushes are given in the drawing. The shaft is bent to make contact when armature is 180° around and to break when 360° around. The two shaft ends are bent in opposite directions, so that there are two contacts during each revolution. The armature must run true and easily and clear magnet at F, by about 1/16". The wire is wound on at W. For convenience the yoke Y may be taken from base. If not, it must be adjusted by placing small pieces of wood under magnet or bearings.



Battery Motor of Few Parts. Iron Parts of Soft Annealed Stock and Only One Magnetizing Coil Required

One end of the coil is fastened to binding post, the other to bearing. The two brushes are connected together. This motor is designed to run on eight cells, four in series and two in multiple. With this power and with a pulley and flywheel on the shaft the motor may be used for driving small mechanical toys. The motor will run light on two cells.

Contributed by WALTER D. SHOLL.

Experimental Chemistry

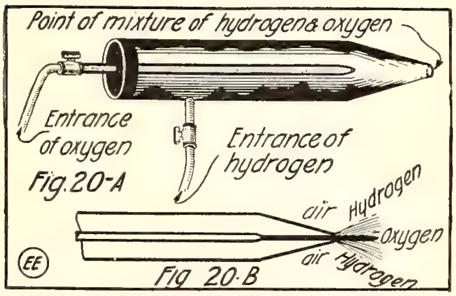
By Albert W. Wilsdon

Fifth Lesson

OXYGEN.

OXYGEN is a colorless, odorless, and tasteless gas. It is the most widely distributed element. It was discovered on August 1st, 1774, by Joseph Priestley, and a few weeks later, Scheele, a Swedish apothecary, published his method of preparing this gas.

Priestley discovered this gas by making



Showing Construction of the Compound Nozzle of the Oxy-Hydrogen Blow Pipe, also How the Gases Combine in the Flame.

Mercuric Oxide (HgO) and, owing to the lack of burners having high temperatures, he had to obtain the required heat to break up this compound by using a large burning glass and focusing the sun's rays on the Mercuric Oxide. He collected the gas under water, in much the same manner as we do now. Priestley called the gas (which is now called Oxygen) *Dephlogisticated Air,* which name is now obsolete.

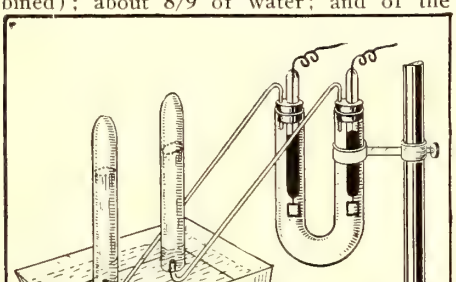
Karl Wilhelm Scheele, a Swedish apothecary, also discovered this gas by a different method than Priestley. Scheele heated Potassium Chlorate ($KClO_3$) and collected the gas in a bladder. He termed this gas *Empyreal Air.*

Shortly after Scheele published his discovery, Condorcet suggested that both Dephlogisticated Air and Empyreal Air be changed to *Vital Air.*

In 1789, Antoine Laurent Lavoisier, a famous French chemist, after a series of carefully conducted and very ingenious experiments, found that the increase in weight of iron, which he burned in oxygen, among his experiments, equaled the weight of the oxygen taken up. By this he proved that the combustion of bodies in air consisted essentially in their combination with *Oxygen* the name which it now retains.

Occurrence and Distribution:

Oxygen is the most widely distributed and most abundant of all the elements. In its free state it constitutes about 1/5 of the atmosphere (here it is mixed, and not combined); about 8/9 of water; and of the



The Water Decomposition Apparatus Complete, Including Catch Tubes.

earth's crust (rocks, limestone, marble, clay, quartz and sand, etc.) about half. It is also contained more or less abundantly in almost all organic compounds, except hydrocarbons, and in every part of animals and plants; and is also found to be a constituent of most acids, bases and salts.

Relation to Life:

Oxygen is essential to all forms of respiration, both in animals and plants. As shown by experiments with mice, etc., if they are deprived of air, they die.

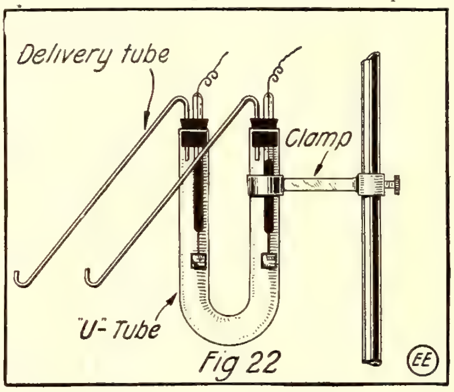
When air (of which oxygen is the chief ingredient) is drawn into the lungs, it gives up a large proportion of its oxygen to the blood which absorbs it readily, and is then carried to all parts of the body by this agent. The numerous tissues are slowly oxidized, during which process heat is liberated, and waste products, the chief one being Carbon Dioxide (CO_2), which is carried by the blood to the lungs and there exhaled.

Let us now perform an experiment whereby we can show the relative amount of Carbon Dioxide which is contained in the lungs.

EXPERIMENT NO. 15.—Take a small beaker or test tube and partially fill it with limewater. Next take a piece of glass tubing and blow your breath into it, causing bubbles to form in the limewater.

You will notice that a curdy white precipitate forms which gradually increases. This is one method of determining the presence of *Carbon Dioxide.*

Because this carbon dioxide which is exhaled from the lungs is called a *waste prod-*



The Electrolysis Cell is Best Supported by a Clamp on a Laboratory Stand as Shown.

uct the reader might assume that this gas has no properties which will benefit anything. This is not so. As we thrive on oxygen so plants thrive on carbon dioxide, which they absorb from the air through their leaves. The plants retain the carbon of this compound (CO_2) in their tissues, much the same as we retain the oxygen of the air in our body, but plants return a large quantity of the oxygen to the atmosphere. (Plants also inhale a very small quantity of oxygen directly from the air, and exhale it as Carbon Dioxide.)

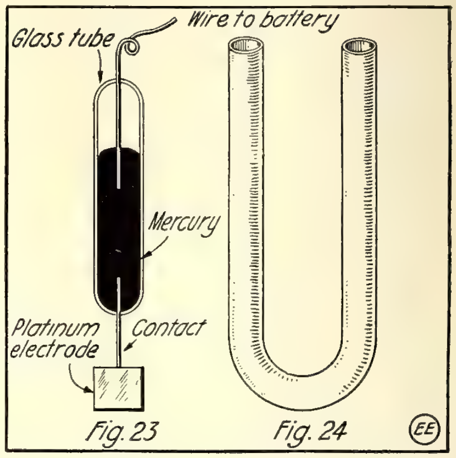
It can be readily seen from the foregoing that plants and animals co-operate in maintaining a quantity of oxygen in the air that is constant.

Many people believe that fishes live without any air whatsoever, because when taken from the water and left in the air for any period of time they die. While fishes do not always obtain *air,* they do obtain the desired oxygen necessary to support life from the dissolved oxygen which the water absorbs from the atmosphere.

PREPARATION:—Oxygen is prepared by various processes. Below are a few of the most important ones:

1. In the laboratory this gas is prepared by heating Potassium Chlorate ($KClO_3$) and Manganese Dioxide (MnO_2) in a closed tube, and collecting the gas by the displacement of water in a receiver, under water.

2. THE BRIN PROCESS:—This consists of forcing pure air, by means of a



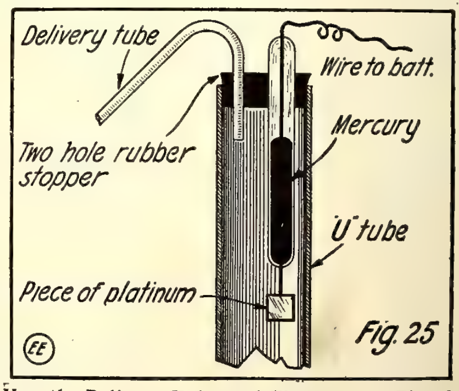
One of Glass Mounted Electrodes and Glass "U" Tube Making Up Electrolysis Cell Used to Decompose Water

pump, over Barium Oxide (BaO) which has been heated to about 700 degrees Centigrade or 1292 degrees Fahrenheit, thereby forming the higher oxide, Barium Dioxide (BaO_2). The air supply is then cut off and the pressure reduced by reversing the pump. By this operation the Barium Dioxide is converted into Barium Oxide and Oxygen. The gas is collected in a reservoir and the process repeated.

3. By the ELECTROLYSIS OF WATER which consists in putting water in the U tube of the apparatus shown by Fig. No. 21 and collecting the oxygen from the anode (or positive electrode). The hydrogen is liberated from the cathode (or negative electrode), and may be collected in the same manner as the oxygen. During the electrolysis of water, twice as much Hydrogen is set free as oxygen.

(It is advisable to introduce a small quantity of Sulphuric Acid (H_2SO_4) into the water to form a better conductor of the electric current. Before adding the Sulphuric Acid to the water carefully read and follow the directions given in the June, 1916, issue of THE ELECTRICAL EXPERIMENTER, under *Laboratory Operations.*)

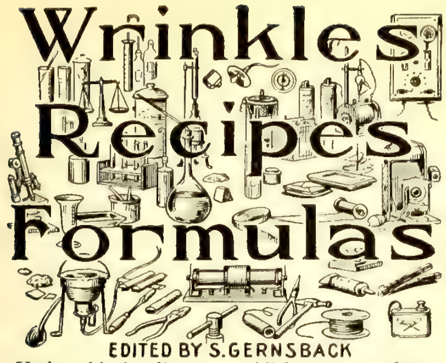
4. Oxygen is prepared in large quantities from LIQUID AIR, the constituents of which are Oxygen and Nitrogen. The prin-



How the Delivery Tube and Electrode are Fitted Thru a Rubber Cork in Top of "U" Tube Chamber of Electrolysis Cell.

ciple of the preparations of Oxygen from Liquid Air lies in the fact that both Oxygen and Nitrogen when in the liquid state,

(*Continued on page 460*)



Under this heading we publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 26.

Polishes—15 Kinds.

Carvers' Polish.—White resin, 2 ozs.; seedlac, 2 ozs.; spirits of wine, 1 pt. Dissolve. It should be laid on warm. Avoid moisture and dampness when used.

French Polish.—Gum shellac, 1 oz.; gum arabic, ¼ oz.; gum copal, ¼ oz. Powder and sift through a piece of muslin; put them in a closely corked bottle with 1 pt. spirits of wine, in a very warm situation, shaking every day till the gums are dissolved; then strain through muslin, and cork for use.

Polish for Dark Colored Woods.—Seedlac, 1 oz.; gum guaiacum, 2 drs.; dragon's blood, 2 drs.; gum mastic, 2 drs.; put in a bottle with 1 pt. spirits of wine, cork close, expose to a moderate heat till the gums are dissolved; strain into a bottle for use, with ¼ gill of linseed oil; shake together.

Waterproof Polish.—Gum benjamin, 2 ozs.; gum sandarac, ¾ oz.; gum anima, ¼ oz.; spirits of wine, 1 pt.; mix in a closely stopped bottle, and place either in a sand bath or in hot water till the gums are dissolved, then strain off the mixture, shake it up with ¼ gill of the best clear poppy oil, and put it by for use.

Finishing Polish.—Gum shellac, 2 drs.; gum benjamin, 2 drs.; put into ½ pt. best rectified spirits of wine in a bottle closely corked; keep in warm place, shaking frequently till the gums are dissolved. When cold, shake up with it two teaspoonfuls of the best clear poppy oil.

Polish for Removing Stains, Spots and Mildew from Furniture.—Take of 98 per cent. alcohol, ½ pint; pulverized resin and gum shellac, of each, ¼ oz. Let these cut in the alcohol; then add linseed oil, ½ pt.; shake well, and apply with a sponge, brush, or cotton flannel, or an old newspaper, rubbing it well after the application, which gives a nice polish.

Polish for Reviving Old Furniture.—Take alcohol, 1½ ozs.; spirits of salts (muriatic acid), ½ oz.; linseed oil, 8 ozs.; best vinegar, ½ pt.; and butter of antimony, 1½ oz.; putting in the vinegar last.

Jet or Polish for Wood or Leather, Black, Red, or Blue.—Alcohol (98 per cent.) 1 pt.; sealing wax, the color desired, 3 sticks; dissolve by heat, and have it warm when applied. A sponge is the best to apply it with.

Polish for Turners' Work.—Dissolve sandarac, 1 oz., in spirit of wine, ½ pt.; next shave beeswax, 1 oz.; and dissolve it in a sufficient quantity of spirits of turpentine to make it into a paste, add the former mixture by degrees to it, then with a woolen cloth apply it to the work while it is in motion in the lathe, and with a soft linen rag polish it. It will appear as if highly varnished.

Furniture Polish.—Beeswax, ½ lb., and ¼ of an oz. of alkanet root; melt together in a pipkin until the former is well colored. Then add linseed oil and spirits of turpentine, of each half a gill; strain through a piece of coarse muslin.

French Polishes.—1. Shellac, 3 lbs.; wood naphtha, 3 pts., dissolve. 2. Shellac, 2 lbs.; powdered mastic and sandarac, of each 1 oz.; copal varnish, ½ pint; spirits of wine, 1 gal. Digest in the cold till dissolved.

Black Walnut Polish.—Take pulverized asphaltum; put in a jar or bottle, pour over it about twice its bulk of turpentine or benzole, put in a warm place, and shake occasionally; when dissolved, strain and apply it to the wood with a cloth or stiff brush; should it prove too dark, dilute with turpentine or benzole. If desired to bring out the grain still more, apply a mixture of boiled oil and turpentine; this is better than oil alone. When the oil is dry the wood can be polished with the following: shellac varnish, 2 parts; boiled oil, 1 part; shake it well before using. Apply with a cloth, rubbing briskly.

To Polish Wood.—Take a piece of pumice-stone and water, and pass repeatedly over the work until the rising of the grain is cut down. Then take powdered tripoli and boiled linseed oil, and polish the work to a bright surface.

Clock Case and Picture Frame Finish.—Copal varnish, 2 lbs.; linseed oil varnish, ½ oz.; mix well, shake often, and place in a warm spot. The wood to be varnished is prepared with a thin coat of glue-water, and rubbed down with fine pumice-stone or something equivalent. In light-colored wood, a light pigment, such as chalk, is added to the glue-water; in dark wood, a dark pigment is added. When ready, the articles are varnished with the above mixture, and, after drying, rubbed with a solution of wax in ether, thereby receiving a high polish.

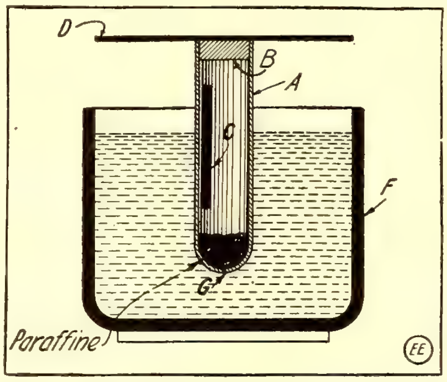
White Polish for White Woods.—White bleached shellac, 3 ozs.; white gum benzoin, 1 oz.; gum sandarac, ½ oz.; spirits of wine or naphtha, 1 pt. Dissolve. S. G.

AN ACID THAT SETS FIRE TO PAPER.

Perchloric acid is one of the most energetic oxidising agents known. The concentrated acid contains 63.68 per cent. of oxygen, with a portion of which it parts most readily in contact with combustible materials. If a drop of the acid is allowed to fall upon a piece of paper, the latter is ignited. It explodes with charcoal, and also, but more violently, with ether. In appearance perchloric acid resembles sulphuric acid, being a colorless oily fluid, 1.78 times as heavy as water.

A SIMPLE WEIGHING BALANCE.

A fairly sensitive scale can be made in a few minutes as follows: Take a test-tube A of about 1 inch diameter by 8 inches long, and put into it some melted paraffine G so that the tube floats upright in water. Fit a cork stopper B into A and glue to B a round tin or brass disc D of about 4 inches diameter. Put the tube A in a glass F containing water. Next put known weights, say ¼, ½ and 1 ounce, on D and mark the waterlevel for these different points on the tube. Prepare a strip of drawing paper and graduate it to suit these marks of ¼, ½ and 1 ounce. Paste this paper scale inside the tube A, taking care to get it in the right place, and the balance is completed. A balance of this type has no parts to get out of order and will serve very well for weighing photographic chemicals, etc.



Small Weighing Balance Made from Test-tube and Vessel Containing Liquid.

Contributed by C. A. OLDROYD.

MAKING A CRYSTAL BASKET.

Water will, especially when boiling, dissolve large quantities of various substances, which, when the water has cooled, are left behind in the form of most beautiful crystals, the shapes of which may vary with the substance employed. One may take advantage of this fact to make very handsome ornaments. It is also known that boiling water will take up a much larger quantity of alum than cold water. If we dissolve as much alum as possible in the former, as the liquid cools, crystals of alum will be deposited on any object placed in the fluid. A piece of coke or cinder allowed to stand in a boiling solution of alum, will become coated with numerous glistening crystals as the liquid cools. It will have the appearance of a naturally formed mineralogical specimen.

Ornamental baskets, etc., may be formed in this way by covering wire or willow baskets. The baskets covered with wire and then cotton are the most successful as the surface to be coated with crystals must be somewhat rough. Take twice as much water as will be sufficient to cover the basket, boil it in a saucepan and add as much alum as will dissolve in the water. A quart of water will require about 18 ounces of alum. Strain this through muslin or blotting paper into a large jar and hang the basket in the boiling liquid. Stand the jar on one side to cool and keep free from dust. In a few hours the basket will be completely covered with white crystals of alum. Should it be desired to color the crystals, add the requisite dye-stuff to the alum solution before straining it. A few drops of cheap dyes will serve the purpose well.

Contributed by H. G. FRANK

SILICA FILLING CEMENT.

Pour one gill of *Silicate of Soda* or *Potash* in a large tumbler (the *Silicate of Soda* or *Potash* is commercially known as *Soluble Glass* and can be bought at any wholesale druggist).

Now add one gill of *Water* to the *Soluble Glass* and mix the two liquids with a wooden stick. In another glass tumbler pour another gill of *Water*, to which is added one gill of *Hydrochloric Acid* (called also *Muriatic Acid*).

Now slowly pour the *Muriatic Acid* and *Water* into the tumbler containing the soluble glass solution and gelatinous silica, which will be thrown to the bottom of the glass, pour off the excess liquid left in the glass. Wash the gelatinous silica in a little water, allow to dry. When dry the silica will be in the form of powder. This powder is pure silica.

Mix the pure silica with soluble glass to which no water has been added, until it forms a creamy paste. Apply quickly. This forms a very hard cement, suitable for repairing and filling in holes, cracks, seams in marble, stone and wood, also glass and almost any place where a hard stone-like cement is needed.

Contributed by MAURICE BERGER.

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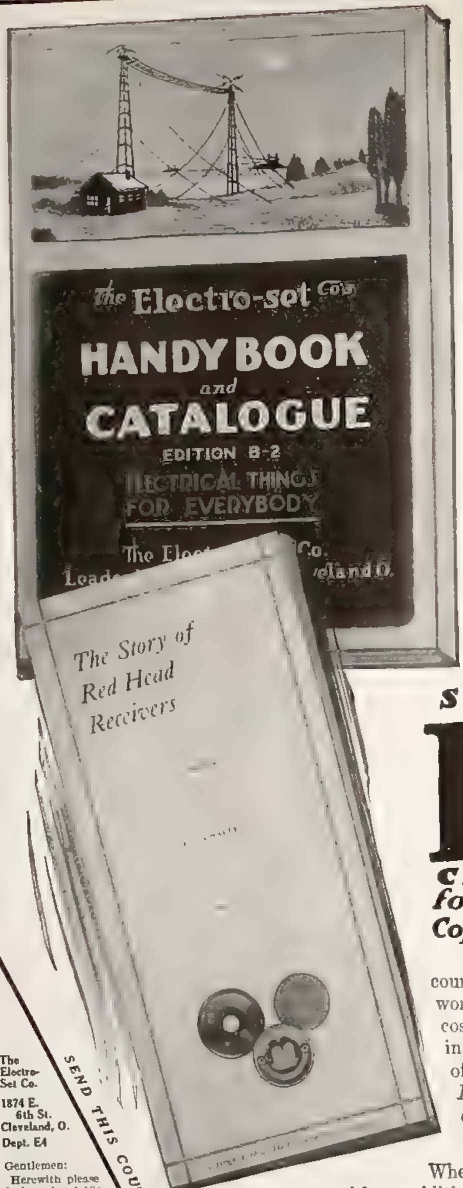
Must have these Two Books



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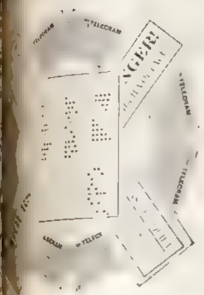

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MOLYBDENUM per ½ oz.	.25	1.25			
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The Electro-set Co.

DEPT. E-4
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Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

EXCELLENT RADIO STATION OF MINOR M. FARLEIGH.

As the photo shows, I constructed two cabinets to make my radio instruments as attractive as possible and still have binding posts to carry on various experiments or be able to place one cabinet on top of the other, without unsightly external connections.

In the cabinet at the left is a complete tuning apparatus, consisting of large loose coupler with necessary taps, loading coil, primary and secondary condensers, together with switches for cutting them in and out.

The cabinet at the right has the Audion detector and amplifier, with necessary batteries and 1 to 1 ratio transformer. In the lower left-hand corner of this cabinet there is a small switch to change for spark or arc transmitters. A variable pencil-mark static reducer is used successfully on the amplifier grid and wing terminals, when necessary. A permanent magnet is used on the detector bulb, which brings in distant stations otherwise inaudible.

This set has given very good results during the past winter in New York City under very unfavorable conditions. The four wire antenna, 90 feet long and 80 feet high was shut off completely to the south and west by towering steel buildings; yet on

Radio Receiving Set of Prize Winner M. M. Farleigh, with Which He Has Picked Up Messages from All Over the United States.

clear nights, steamers working off Florida could be heard distinctly, and most of the Naval and commercial stations along the Atlantic coast from Portsmouth NAC down to Miami.

Countless Amateurs have been heard, including a few in the middle west; NAA and WST come in quite clearly, using a gas-pipe line in the house for an aerial.

I attribute a great deal of the results under these unfavorable conditions to a good ground obtained by running a 75 foot No. 4 stranded copper wire direct to a water pipe near the ground in the cellar. Experiments proved this ground to be far superior to a connection made to water pipes on the fifth floor, where the instruments were located.

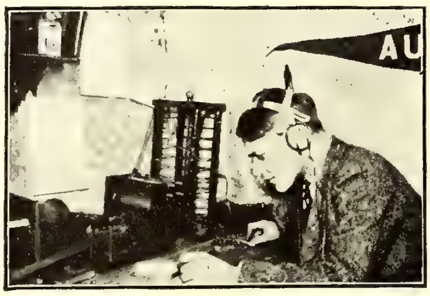
I am now using this set for the summer on Long Island and with a 60 foot aerial, 30 feet high, have heard Key West two feet from the head 'phones during the warmest nights of late June.

I thank all the amateurs whose descriptions I have studied in the monthly contest, for from their ideas, I was able to construct my own set.

MINOR M. FARLEIGH.
New York City, N.Y.

WIRELESS STATION OF HOWARD YOUNG.

My radio receiving set consists of a loose coupler and loading coil, each rated at 2,000 meters, also variable and fixed



Mr. Howard Young busy at His Radio Set. His Call Is 8AW.

condensers. I have a double detector, silicon and galena, and can employ either by throwing a switch. My 'phones are Brande's superior type.

In my sending outfit I utilize a one-inch spark coil operated by a 12-volt storage battery. By means of this I can talk with other amateurs 5 miles distant. My aerial is 200 feet long and 50 feet high, composed of four strands and spaced 2½ feet apart.

I obtain good results from my set as I hear NAA quite loud at noon and can hear some stations with the 'phone held several inches away from my ears. I have been working with wireless for about a year. My call is 8 AW.

HOWARD YOUNG.
Camp Chase, Ohio.

NEW SPERRY WIRELESS UNIT FOR AEROS.

Uncle Sam has succeeded in outstripping other nations in at least one branch of army service—that of wireless instruments for aeroplane reconnaissance. Compressed into a little package that an aviator might almost stick into his pocket is a new wireless instrument capable of carrying messages for sixteen miles, and weighing only seven pounds.

The device is the invention of Elmer A. and Lawrence B. Sperry of gyroscope fame. According to Henry A. Woodhouse, member of the board of governors of the Aero Club of America and director of the American Society of Aeronautic Engineers, the miniature wireless will revolutionize the use of such instruments and will give the nation which controls its use a marked advantage.

"Heretofore, radio sets have weighed from two to four pounds for every mile radius," said Mr. Woodhouse. "It always has been thought that an ideal set would be one that would weigh one pound for each mile radius. This instrument, as it has been shown, has far outstripped even the hopes of other inventors, and the most hopeful part of the discovery is the fact that its radius may be increased with but a slight proportionate increase in weight."

RAYMOND SMITH'S RADIO STATION.

The transmitting apparatus in my station consists of the following: A ½ K. W. Electro Importing Company's transformer; plate glass condenser, stationary spark gap and a helix converted into an oscillation transformer, and an electrolytic interrupter to interrupt the primary circuit and a transmitting key with extra large contacts.

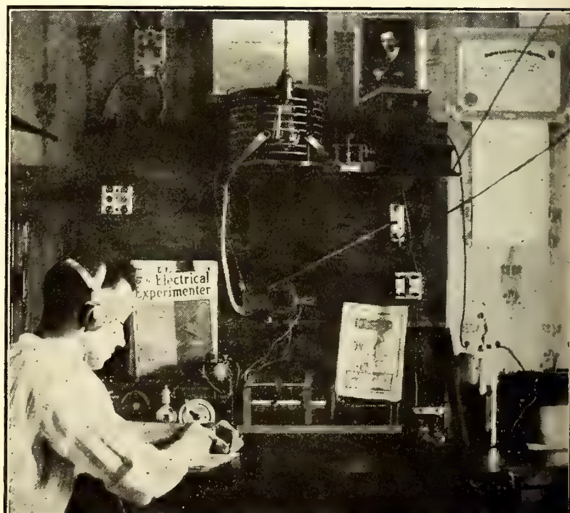
On the receiving side I use the following with very good success: A 3,000 meter loose coupler, De Forest Audion, variable condenser in parallel with the secondary of the receiving transformer and Murdock 2,000 ohm 'phones.

I have one wire aerial 500 feet long for receiving long wave stations and a three wire aerial 70 feet long and 40 feet high for transmitting and receiving from amateur stations.

With this outfit a daylight receiving range of 1,500 miles is attained, while the Amateurs from every part of the state are tuned in with ease.

My transmitting set has successfully covered a distance of 16 miles. I am at present working on an undamped wave receiving set, and when this is finished a photo and description will be sent to THE ELECTRICAL EXPERIMENTER.

I am a member of The Radio League of



The Complete Wireless Set of Mr. Raymond Smith, of Tippecanoe City, Ohio. Call 8KL.

America and the Central Radio Association, also hold a second grade government license with an official call of 8 KL.

Tippecanoe City, O. RAYMOND SMITH.

WIRELESS EQUIPMENT OF H. A. DePALMA.

Among my radio receiving apparatus there are two loose couplers, one of the Navy type, which is controlled by

Excellent Radio Outfit of H. A. DePalma. He Holds a Membership in the Radio League of America.

switches and has a range of 4,500 meters. The other one I use for shorter wave lengths, but each of them can tune in NAW very accurately, as well as NAA. I also use a Clapp-Eastham variable condenser, a pair of Brandes' 1,000 ohm 'phones, one Holtzer-Cabot 'phone, and Electro Importing Company's fixed receiving condenser, also a Murdock silicon detector, which works very efficiently.

The sending set comprises a one-inch coil and a rotary spark gap, which produces a pure, musical pitched note. A serviceable silver contact key is used with a shunt condenser. The D.P.D.T. switch can be thrown to either side with ease. I have a very large aerial of the umbrella type, occupying the roofs of a whole city block, the wires extending in every direction in very long lengths.

I would also like to mention the fact that I cannot do without THE ELECTRICAL EXPERIMENTER magazine, as it is the greatest help in my researches and experiments. I am also a member of The Radio League of America.

H. A. de PALMA.

New York City, N.Y.

WIRELESS OPERATORS WANTED BY THE NAVY.

The Navy wants wireless operators who will volunteer their service in case an emergency should arise. This is the word given out by Sam Schnelle, navy recruiting officer at Evansville, Ind. He has received instructions from the New York headquarters to secure the consent of any amateur wireless operators to offer their services in case of war. The applicant is required to give his services only in time of need, and his name will be placed on the honor roll of the country.

UNDERGROUND PHONE NOW.

Dr. H. Barringer Cox announces that he has perfected a subterranean wireless telephone and incidentally discovered a new law of physics—that electrical energy can be transmitted over a single conductor.

For the last five months Dr. Cox has been working at Los Olives, Cal., with the United States forest service experts in an effort to perfect a system of wireless signals for forest fires.

It was while so engaged that he discovered the possibilities of transmitting the human voice through the ground.

His equipment consists of an ordinary telephone transmitter connected with a battery and a special instrument—Dr. Cox's secret—with a ground wire. At the receiving station, five or fifty miles away, is a similar equipment.

LONG DISTANCE TELEPHONE TO HAVANA.

On the completion of the long distance line to Key West, Fla., by the American Telephone and Telegraph Company, steps will be taken to lay a submarine cable between that point and Havana, Cuba.

MR. W. DENNIS A WIRELESS ENTHUSIAST.

In the illustration one may perceive a 4,000 meter loose coupler, located on top of the cabinet and a 21 point loading coil, a fixed variable condenser, with six points. The "buzzer test" is controlled by a flush type push button, located in the right-hand corner. The cat-whisker detector is on the left-hand side. This set, with the exception

Mr. W. Dennis and His 4000 Meter Radio Receiving Set.

of loose coupler and 1,000 ohm receiver, is all home-made.

W. DENNIS.

Des Moines, Iowa.

Amateur News

Germantown Radio Association Now the Philadelphia Radio Association.

This association was formed three years ago with five members, and at the present time has about 150 members on its roll. The association holds its meetings at 5801 Germantown Ave., on the third Monday of each month. Its members have the use of the club library; a wave meter, which was calibrated by the Bureau of Standards of Washington, D. C., a large dance floor, and an up-to-date piano in the club room, which is about 100 x 45 feet.

There is an aerial over the building which is used for demonstrating various apparatus. The club also offers good speakers, and among those who have spoken are Mr. A. B. Cole, of New York; Prof. L. Knoll, of Central High School, Philadelphia; Mr. Chas. Ballantine of N. E. M. T. S., Philadelphia; Mr. E. E. Hubbs, Philadelphia; Mr. S. S. Harris, Philadelphia; Mr. F. B. Chambers, Philadelphia; Mr. Paul B. Huyette, Philadelphia; Mr. Charles Stewart, St. Davies, Pa., and several others of note. The association dues are $1.00 per year; each member receiving a card identifying him with the club.

The officers are as follows: President, W. F. Wunder; Vice-President, E. E. Hubbs; Treasurer, J. Hamilton; Recording Secretary, C. Ballantine; Corresponding Secretary, S. S. Harris. Entertainment Committee—Paul B. Huyette; Pin Committee (three members), Membership Committee (four members), Technical Committee (four members); Research Committee (four members), Press Committee (three members), Legislative Committee —Charles Stewart.

The business of the association is carried on by a board of directors consisting of seventeen members and the president. The club prints a club paper known as *The Oscillator*. The officers invite correspondence and attendance at the club meetings.

The Mountain States Radio Association.

A radio club, under the name of "The Mountain States Radio Association," has been organized at Denver, Colo., for the purpose of promoting radio communication among the amateurs of the Rocky Mountain region. Two meetings have been held and the following officers elected: President, D. L. Clark; Vice-President, R. S. Whitaker; Secretary, C. F. Neumann; Treasurer, A. J. Winterer; Chief Operators, E. R. La Duke.

The club consists entirely of licensed members, this being one of the requirements of admission. A "time" sending service has been inaugurated and the time, as received by the chief operator from Arlington, is sent out nightly at nine o'clock, on a two hundred-meter wave-length.

Communications from other clubs are invited and should be sent to the secretary at 1523 South Ogden St., Denver, Colo.

Boy Scouts of Sch. Haven, Pa., Radio Enthusiasts.

The Boy Scouts of this city have organized a wireless and research committee and the following members have been chosen: Carl S. Dress, John H. Baker, William Stauffer, Donald Eiler and Charles Kaufman.

Carl Dress, John Baker and Donald Eiler are the wireless operators. The whole organization will in the near future have a fine laboratory.

Address all communications to Carl S. Dress, 22 to 24 E. William St., Sch. Haven, Pa.

The Rhode Island Radio League.

The Rhode Island Radio League was organized for grouping the various amateurs in Rhode Island. At a recent meeting, held by the officers of the league, "calls" were assigned to the members who were not already supplied with Government calls. The idea of this assignment is to facilitate the calling of each club member. On Dec. 5 the following officers were elected for a term of one year: Ralph J. Liedel, president and treasurer; James G. Sacs secretary; Bernard Riley, station inspector.

The station inspector is a newly created office. He inspects the stations of the members and advises them what would be the best way to arrange their sets, etc. In other words, he is a source of general information for the club members.

All communications to the club should be addressed to the secretary, Jas. G. Sacs, 124 Prairie Ave., Providence, R. I., or call A-1-1 or A-1-2 "via wireless."

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur News" Section, The Electrical Experimenter, 233 Fulton St., New York City.

Formation of the New Rochelle Radio League.

The amateur wireless workers of New Rochelle, N.Y., met on February 3, 1916, and formed a radio club for the advancement and betterment of wireless in this city. The club is to be known as The Radio Club of New Rochelle, N.Y.

The club was formed on a substantial basis, he initial membership being twenty. The following officers were elected: President, John Bucknam; vice-president, Etienne Donovan; secretary and treasurer, Thomas Havard; press agent, Edward Bettels. Under these competent executive officers, the club is expected to flourish.

A library with books pertaining to electricity and wireless is an important consideration. A committee was appointed to handle this work. An electrical committee was also appointed to supervise the experiments and take charge of the large station installed by the club.

Other clubs are invited to correspond with the secretary, Thomas Havard, 48 John Street, New Rochelle, N.Y.

RADIO EXPERIMENTER'S ASSOC. OF THE STATE N. Y.

A radio experimenters' association bearing the above name has been organized and the following officers elected: President, Walter L. Miller; Vice-president, Marion Cimma; Secretary and Treasurer, Manager of the operating staff and Librarian, M. Kestenbaum.

Before the meeting adjourned it was unanimously voted that all members join the Radio League of America.

The object of the association is the furtherance of knowledge in the science of Wireless Telegraphy and Telephony among the amateurs to bring them into closer relationship and to mutually help all those interested. Write to the Secretary, 510 W. One Hundred and Forty-seventh St., New York, N.Y. Prospective members shrould write to the President, Walter L. Miller, 96 Pitt St., New York, N.Y.

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK, UNTIL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the month of March, 1916. (Continued.)

SECOND DISTRICT—(Cont'd).

Call signal	Owner of station.	Location of station.	Power kilowatts.
2AMK	Allin, Willis F.	1148 Fairmont Ave., Elizabeth, N.J.	.5
2ALV	Atkinson, Benjamin	496 Park Ave., Paterson, N. J.	.5
2AMR	Avery, John	4 Spruce St., Corona, N. Y.	.5
2AMH	Bettels, Edward T.	56 Rockdale Ave., New Rochelle, N. Y.	.5
2ALW	Benson, Warren S.	4 Fuller Pl., New York, N. Y.	.5
2ANT	Brown, Mortimer	Sayville, N. Y.	.5
2AMI	Brush, Geo. S., Jr.	326 E. Main St., Patchogue, N. Y. (In partnership with Howard Van Cleaf.)	.5
2AMW	Coon, George	36 116th St., New York, N. Y.	.5
2ANQ	Crowe, Howard A.	Harrison, N. Y.	.5
2KI	Eaton, Donald	1533 St. Nicholas Ave., New York, N. Y.	1
2ALE	Fingerlin, Harold J.	296 Washington Ave., Rockaway Beach, N. Y.	.5
2ANF	Fish, Edward H.	27 Highland Ave., Middletown, N. Y.	.5
2ANM	Foot, N. Brainard	1432 75th St., Brooklyn, N Y.	.5
2AME	Frank, Richard	408 Main St., Union, N. J.	.5
2AMY	Geils, Henry	1 Walton Ave., New York, N. Y.	.5
2ANC	Guy, Raymond F.	342 Broadway, Tottenville, N. Y.	1
2AMN	Hart, Phillip	225 Brighton Ave., Perth Amboy, N. J.	.5
2ANI	Heinzmann, Milton	991 Chancellor Ave., Irvington, N. J.	.5
2AMO	Heiss, Walter	51 Crawford St., Newark, N. J.	.5
2ANV	Hirschfield, Edward	338 W. 18th St., New York, N. Y.	.5
2ALX	Hobson, Christopher E.	1018 ColumbusAve., Westfield, N.J.	1
2ANJ	Hoff, Russell S.	298 Western Ave., Albany, N. Y.	.5
2ALO	Huff, Frederick W.	665 State St., Perth Amboy, N. J.	.5
2ALP	Hulse, Tremaine	32 3d Ave., Bayshore, N. Y.	.5
2AMS	Hunter, John W.	68th St., and 2d Ave., Brooklyn, N. Y.	.5
2AMG	Jaques, Channing K.	150 Elm St., New Rochelle, N. Y.	.5
2ALR	Kells, David G.	253 73d St., Brooklyn, N. Y.	.5
2ANG	Kirschoff, Willard J.	438 E. 148th St., New York, N. Y.	.5
2AND	Klane, Fred C., Jr.	Harrison, N. Y.	.5
2ANS	Koyen, Walter R.	Woodbridge, N. J.	.5
2ANB	Leo, Nelson	600 W. 183d St., New York, N. Y.	.5
2ANA	Lindheimer, Carl M.	102 Watson Ave., Newark, N. J.	1
2ALN	Mason, Percy H.	106 Lewis St., Paterson, N. J.	.5
2ANE	McLean, True	38 Central Ave., Tomkinsville, N.Y.	1
2ANU	Midgley, Herbert	59 Brewster St., Tompkinsville, N. Y.	.5
2AML	Mueller, Carl F., Jr.	440 Monroe Ave., Elizabeth, N. J.	1
2ALQ	Mulvaney, Thomas	1903 Barnes Ave., Westchester, N.Y.	.5
2ANO	Nelson, Irving J.	80 E. 115th St., New York, N. Y.	.5
2ALS	Oetjen, John J.	543 17th St., West New York, N. J.	.5
2ALU	Peiler, Harold L.	321 E. 90th St., New York, N. Y.	.5
2ANH	Raufer, Frank J.	50 Shepherd Ave., Brooklyn, N. Y.	.5
2AMJ	Ruddy, Geo. F.	186 High St., Perth Amboy, N. J.	.5
2AMZ	Roehrich, Henry	2 Belmont Ave., Garfield, N. J.	.5
2ANN	Roquer, Leon E.	76 Fox Ter., Dunwoodie, N. Y.	.5
2ANW	Schaefer Maximillian	73 W. 115th St., New York, N. Y.	.5
2AMC	Seiler, Frank B.	54 Elm St., Summit, N. J.	.5
2ANK	Seitz, Wesley	7 Seitz Court, Patchogue, N. Y.	.5
2ANX	Shaw, Albert E., Jr.	1060 72d St., Brooklyn, N. Y.	.5
2ALM	Sheldon, Henry B.	26 Main St., Keyport, N. J.	.5
2AMF	Smith, Wm. W.	207 Wegman Parkway, Jersey City, N. J.	.5
2AMU	Tennon, Evans, H.	705 1st Ave., Asbury Park, N. J.	.5
2ANP	Valentine, Russell D.	165 Amboy Ave., Woodbridge, N.J.	.5
2AMI	Van Cleaf, Howard	326 E. Main St., Patchogue, N. Y.	.5
2AMB	Van Dyke, Theo. F., Jr.	246 Morris Ave., Summit, N. J.	.5
2ALT	Van Loan, Harold H.	Athens, N. Y.	.5
2AMT	Voipel, Daniel, Jr.	1162 Forest Ave., New York, N. Y.	.5
2AMP	Von Ardyn, John	125 Riverside Drive, New York, N.Y.	.5
2AMQ	Von Frankendorff, L.	403 S. 7th St., Newark, N. J.	.5
2ANR	Walcutt, Frank	841 W. 179th St., New York, N. Y.	.5
2AMD	Weatherbee, W T.	Millington, N. J.	.5
2AMX	Whittleton, Harry M.	Palisades Park, N. J.	.5

THIRD DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
3ARW	Braston, Frank, Jr.	3732 Locust St., Philadelphia, Pa.	.5
3ARF	Beck, Page M.	300 Minor St., Richmond, Va.	.5
3ARL	Belt, Wm. B.	Hyattsville, Md.	.5
3ASF	Blaess, Geo.	2106 N. 5th St., Philadelphia, Pa.	.5
3ARD	Brautigam, Harry G.	5714 American St., Philadelphia, Pa.	.5
3ASM	Britt, Chas. J.	Arlington, Pa.	.5
3AOR	Cook, Chas. F.	Yardley, Pa.	.5
3ARE	Cullin, E. N.	1762 Willard St., Washington, D.C.	.5
3ASD	Damon, Lester R.	2517 N. 9th St., Philadelphia, Pa.	.5
3ARH	Drexel Radio Club	Drexel Institute, Philadelphia, Pa.	.5
3QY	Frank H. Stewart Elec. Co.	37-39 N. 7th St., Philadelphia, Pa.	.5
3ARM	Flumerfelt, E. Clinton	Polkville, N. J.	.5
3AOP	Gilbert, Clifford W.	1620 N. 17th St., Philadelphia, Pa.	.5
3ARI	Gillen, John J.	2134 Christian St., Philadelphia, Pa	.5
3ART	Harvey, Walter E.	233 N. Broad St., Trenton, N. J.	.5
3ARN	Hunt, Harry L.	1006 Wilkesbarre St., Easton, Pa.	.5
3ARP	Hunter, H. Clifford	226 E. Lancaster Ave., Wayne, Pa.	.5
3ASK	Jordan, Pendleton A., Jr.	339 Main St., Suffolk, Va.	.5
3ARG	Kelley, Ray F.	1042 S. Paxon St., Philadelphia, Pa.	.5
3ASP	Lewis, John C., Jr.	4014 Penhurst Ave., Baltimore, Md	.5
3AOS	Lister, Robert W.	102 Overbrook Ave., Trenton, N. J.	.5
3ASI	Marts, Harvey	836 Central Ave., Ocean City, N. J.	.5
3ASG	McKnett, Robert R.	3147 W. Gordon St., Philadelphia, Pa.	.5
3ARS	McNair, Wm. D.	1933 Biltmore St., Washington, D. C.	.5
3ASA	Milner, Robert D.	3335 Tennyson St., N. W., Washington, D. C.	.5
3ASN	Minnick, Otis	42 Fairview Ave., Cumberland Md	.5
3AOM	O'Brien, Francis J.	2226 N. Carlisle St., Philadelphia, Pa.	1
3RM	Phillips, John D.	612 N. 2d St., Reading, Pa.	1
3ARK	Radio Association of Maryland	Bancroft Rd., Arlington, Md.	1
3AOT	Ratcliffe, Wm. E.	352 Brunswick Ave., Trenton, N.J.	.5
3AOW	Roethlinger, Chas. A.	431 W. Susquehanna Ave., Philadelphia, Pa.	.5

THIRD DISTRICT—(Cont'd).

Call signal	Owner of station.	Location of station.	Power kilowatts.
3ARA	Shaw, R. Russell	207 High St., Burlington, N. J.	.5
3UD	Silvers, Frank H., Jr.	430 Princeton Ave., Trenton, N. J.	.5
3ASH	Snape, Edwin A., Jr.	318 W. Logan St., Philadelphia, Pa.	.5
	Stewart Electric Co.	Philadelphia, Pa. (See Frank H. Stewart Elec. Co.)	
3AON	Strang, Harry L.	2020 1st St., N. W., Washington, D. C.	.5
3ASL	Tallmadge, Richard H.	Chatham, N. J.	.5
3ASO	University of Pennsylvania	Philadelphia, Pa.	.5
3ARO	Wight, Donald M.	1620 29th St., Washington, D. C.	.5

FOURTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
4DR	Brantley, Lewis B.	534 5th St., N., St. Petersburg, Fla.	.5
4DS	Edwards, W. Leroy	32 Prospect Pl., Atlanta, Ga.	.5
4DO	Stalnaker, Leo	6th Ave., and 33d St., Tampa, Fla.	.5
4DQ	Tabb, Vincent W.	A. & M. College, West Raleigh, N.C.	1
4DP	Warner, Geo. C.	609 Swann Ave., Tampa, Fla.	1

FIFTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
5DX	Ancell, Tom B.	927 N. Marsalis Ave., Dallas Tex.	1
5ED	Autry, Jas. L., Jr.	5 Courtlandt Pl., Houston, Tex.	1
5EF	Baker, Chas. M.	507 N. 1st St. Temple, Tex.	.5
5CS	Beauchamp, Fred	Orange, Tex. (Boy Scouts Station)	.5
	Boy Scouts of America	Orange, Tex. (See Beauchamp, Fred)	
5DR	Caine, Irving D.	2211 Avenue H., Ensley, Ala.	1
5EB	Carrie, Robert G.	746 Herron St., Montgomery, Ala.	.5
5DY	Downing, Roswell B.	727 E. 6th St., Oklahoma City, Okla	.5
5DU	Emerson, Bennett	3730 Wendelkin St., Dallas, Tex.	1
5EG	Hudson, Edward M.	608 W. 7th St., Austin Tex.	.5
5DV	Hunt, Martin L.	Woodrow St., Dallas, Tex.	1
5EI	Kelly, Paul R.	3707 Junius St., Dallas, Tex.	.5
5EA	McDonnell, J. S., Jr.	3304 8th Ave., Little Rock, Ark.	.5
5DT	Reeves, Ben	2822 Turney Ave., Dallas, Tex.	.5
5EC	Reymond, Dalton S.	442 N. Boulevard, Baton Rouge, La.	.5
5AB	Steddom, A. Henry	1524 W. 9th St., Oklahoma City, Okla.	1
5DQ	Stanton, Roy	1002 Cedar St., Bonham, Tex.	.5

SIXTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
6GU	Anzini, Daniel I.	Mountain View, Cal.	.5
6NY	Bagley, Wm. C.	615 Johnson St., Santa Rosa, Cal.	.5
6LR	Baker, Jesse E.	2913 Lorina St., Berkeley, Cal.	1
6TG	Blodgett, Harry O.	1953 Bonsallo Ave., Los Angeles, Cal.	.5
6LZ	Burgess, Chas. W.	506 N. Philadelphia St., Anaheim, Cal.	.5
6NM	Carter, Kenneth L.	633 W. H. St., Colton, Cal.	1
6KN	Davidson, Geo. A.	Chula Vista, Cal.	1
6HY	Davidson, Merritt T.	1954 Hillcrest Rd., Hollywood, Cal.	.5
6RX	Dieterich, Martin	430 E. 12th St., Los Angeles, Cal.	.5
6LQ	Duborg, Geo.	845 Sierra St., Reno, Nev.	.5
6TQ	Emmerton, Alfred	167 S. 4th St., Sawtelle, Cal.	.5
6LM	Erler, Robert J.	114½ Santa Clara St., Vallejo, Cal.	.5
6LT	Farolita, Dominic A.	289 Chenery St., San Francisco, Cal.	.5
6BZ		1035 E. 1st St., Santa Ana, Cal.	.5
6RW	Garver, Oliver B.	1960 Vista Del Mar, Hollywood, Cal.	.5
6HX	Hare, Robert J.	1238 W. 38th St., Los Angeles, Cal.	.5
6RR	Herman, Edward W.	735 19th St., San Diego, Cal.	.5
6JC	Homand, Jas. A.	1423 McKinley St., Los Angeles, Cal.	.5
6MI	Hooper, Herbert D.	Sultana, Cal.	.5
6SX	Johnson, Alfred E.	1030 Delaware St., Berkeley, Cal.	1
6QV	Kimm, Geo. N.	2502 Q St., Bakersfield, Cal.	.5
6OF	Kroman, Robert	Napa, Cal.	.5
6BX	Lankston, J. M.	152 Ohio Ave., Sawtelle, Cal.	1
6MW	Lauritsen, Albert M.	Napa, Cal.	.5
6KU	Mealer, Loyal D.	Walnut Grove, Cal.	1
6KP	Miller, Murray R.	15 E. Central Ave., Redlands, Cal.	1
6QA	Myers, Harry	3215 N. Broadway, Los Angeles, Cal.	.5
6KB	Olmstead, Chas. B.	259 N. 23d Ave., Los Angeles, Cal.	.5
6JZ	O'Neill, Frank M.	1635 Addison St., Berkeley, Cal.	1
6JX	Pollitt, Chalmer L.	663 W. 35th Pl., Los Angeles, Cal.	.5
6HZ	Roe, Chas D.	661 S. Chicago St., Los Angeles, Cal.	.5
6HU	Rutledge, Ralph	401 10th St., Colusa, Cal.	.5
6OZ	Sanford, J. Gordon	1117 W. 78th St., Los Angeles, Cal	.5
6FZ	Schroeder, Arthur R.	Mountain View, Cal.	.5
6NO	Spaulding, Leland J.	172 32d Ave., San Francisco, Cal.	.5
6NZ	Spicer, Clarence	1005 Riverene Ave., Santa Ana, Cal	.5
6TT	Stewart, Francis S.	1919 Fern St., San Diego, Cal.	.5
6MZ	Stoudt, Frank L.	340 Francis St., Pomona, Cal.	.5
6OB	Telmont, Hippolyte B.	Mayfield, Cal.	.5
6KX	Thomas, Courte D.	2801 La Salle Ave., Los Angeles, Cal.	1

SEVENTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
7QD	Benoit, Neville R.	869 S. 41st St., Tacoma, Wash.	.5
7BA	Bischoff, Clarence L.	7417 53d Ave., S. E., Portland, Ore.	.5
7BT	Boslair, Orin E.	Vancouver, Wash.	.5
7LE	Bracht, Leon E.	Calabar, Mont.	.5
7MK	Callender, Melville H.	593 15th St., Astoria, Ore.	.5
7CT	Carpenter, Edward L., Jr.	119 E. 5th St., Aberdeen, Wash.	.5
7SG	Gianelli, Salver A.	517 E. Sharp Ave., Spokane, Wash	.5
7ND	Grush, David R.	383 19th St., Astoria, Ore.	.5
7RI	Hager, Clement S.	1019 E. 54th St., Tacoma, Wash.	.5
7OC	Heifort, Earle R.	707 Lincoln St., Port Townsend, Wash.	.5
7GP	Hunter, Guy A.	518 Willow St., Port Townsend, Wash.	.5
7JP	Jolly, Chas. W.	507 Prospect Ave., Lewiston, Idaho	.5
7ML	Mason, Howard F.	3566 Morgan St., Seattle, Wash.	.5
7CU	McDermott, Thomas H.	339 26th Ave., Seattle, Wash.	.5
7WP	Ralston, Graham W.	Port Townsend, Wash.	.5
7JS	Ramsay, James S.	215 E. 9th St., Ellensburg, Wash.	.5
7FR	Rush, Floyd M.	930 S. 13th St., Salem, Ore.	.5
7MR	Spikder, Emmet E.	715 10th St., Lewiston, Idaho	.5
7VA	Vreeland, Thad	210 Graham Ave., Portland, Ore.	1
7KM	Watkins, Leslie W.	Wheatland, Wyo.	.5
7SI	Weagle, S. A.	2006 Cove Ave., La Grande, Ore.	.5
7WL	Wilson, Herbert A.	365 14th St. Astoria, Ore.	.5

(*Continued on opposite page.*)

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK, UNTIL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of March, 1916. (Continued.)

EIGHTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
8CD	Benz, Carroll	326 S. 5th Ave., Ann Arbor, Mich.	.5
8CM	Bieber, Carl W.	16 Hauf St., Buffalo, N. Y.	.5
8GY	Birkel, Lawrence J.	700 Tibbets Ave., Springfield, O.	.5
8TQ	Brooks, Clarence H.	278 Emerson St., Rochester, N. Y.	.5
8UQ	Leary, Robert	27 Inwood Pl., Buffalo, N. Y.	.5
8FQ	Phelps, Raymond W.	203 N. Almer St., Caro, Mich.	.5
8CE	Reeves, Arthur A., Jr.	288 Emerson St., Rochester, N. Y.	.5
8HN	Schlegel, Raymond G.	1118 N. Negley Ave., Pittsburgh, Pa.	.5
8HF	Weemhoff, S. J.	1152 Lafayette Ave., S.E., Grand Rapids, Mich.	.5
8EM	Wilkinson, Howard E.	239 Blaine Ave., Buffalo, N. Y.	.5
8TR	Yaeger, Henry	1036 N. Clinton Ave., Rochester, N. Y.	.5

NINTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
9FV	Aldrich, Clinton P.	6405 Emerald Ave., Chicago, Ill.	.5
9ADY	Clapp, Newell	Ellsworth, Wisc.	1
9ADT	Hartmann, Gilbert and Martin	210 State St., Wauwatosa, Wisc.	1
9ADW	Hicks, Verner	306 E. Marion St., Marion, Ill.	1
9ADV	Joslin, Murray	Independence, Iowa	1
9ADZ	McDonald, Edgar J.	5526 Lakewood Ave., Chicago, Ill.	.5
9EO	McNeill, Malcom R.	1310 Maple Ave., Evanston, Ill.	.5
9ADX	Roe, Vancil V.	Pillsbury Academy, Owatonna, Minn.	1
9ADS	Spalding John G.	1328 Brook St., Louisville, Ky.	.5
9ADR	Wallace, Wm. A.	Brush, Colo.	1
9ADU	Whitaker, Ralph S.	1823 S. Washington St., Denver, Colo.	1

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of April, 1916.

FIRST DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
1ENK	American Radio Ass'n	8 Cedar Court Wakefield, Mass.	.5
1ESP	Bradshaw, Norwood V.	56 Elm St., Putnam, Conn.	.5
1ESM	Brennan, Edward G.	Bedford St., Stamford, Conn.	.5
1ENT	Brothers, Geo. W.	78 Central St., Hudson, Mass.	.5
1ESB	Byron, Myles	52 W. Liberty St., Waterbury Conn.	.5
1ESF	Feeney, Elton O.	181 Allen Ave., Portland, Me.	.5
1ENH	Grenier, Leonard J.	43 Hamlet Ave., Woonsocket, R. I.	1
1ESG	Hampton, Wm. G.	107 Grove St., Fall River, Mass.	.5
1ESO	Howard, Frank W.	38 Main St. Dexter, Me.	.5
1ENP	Kollen, Henry T.	996 Eddy St., Providence, R. I.	.5
1ESD	Lyman, Charles F., Jr.	Dover, Mass.	.5
1ESJ	Morrill, Donald H.	424 Wethersfield Ave., Hartford, Conn.	.5
1ESL	Morris, Joseph A.	56 Cedar St., New Britain, Conn.	1
1ESE	O'Neill, John D.	Leonard St., Stamford, Conn.	.5
1ESI	Phelan, Harold	35 Cedar St., Wakefield, Mass.	.5
1AS	Sheffield, Irving J.	25 Warren St., Hallowell, Me.	1
1ESN	Wright, Ira H.	12 Closson St., Methuen, Mass.	.5

SECOND DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
2APX	Baker, Alvah L.	253 W. 116th St. New York, N. Y.	.5
——	Barron Ave. High School	Woodbridge, N. J. (See Love, John H.)	
2AQM	Borax, Isidor	226 W. 121st St., New York, N. Y.	.5
2APR	Carpenter Stephen C.	273 S. Main St., Hempstead, N. Y.	.5
2AQJ	Clarkin Wm.	2416 Morris Ave., New York, N. Y.	.5
2AOK	Class, Charles L.	38 Vernon Ter., East Orange, N. J.	.5
2AAQ	Drury, Frank	21 Amherst Ave., Jamaica N. Y.	.5
2AV	Eastern District Y.M.C.A.	179 Marcy Ave., New York, N.Y.	.5
2LE	Egolf, Richard S.	1122 49th St., Brooklyn, N. Y.	.5
2AOO	Erven, Raymond P.	Keansburg, N. J.	.5
2AQC	Gardner, Wm. E.	15 Prospect St., Adams, N. Y.	.5
2DO	Guldi, Walter E.	Sayville, N. Y.	.5
2DD	Hammond Fremont M.	160 E. Main St., Patchogue, N. Y.	.5
2APN	Hausrath, Alfred H.	1866 Cedar Ave., New York N. Y.	.5
2ADG	Hegmegee, Joseph O. L.	235 River Drive, Garfield, N. J.	.5
2AOL	Horn, Charles W.	379 Broadway, Far Rockaway N. Y.	.5
2BW	Hynes, Eugene	2429 Valentine Ave., New York, N. Y.	.5
2AQD	Ingalls, Howard S.	Hamilton, N. Y.	.5
2AQB	Jacquet, Lloyd	478-A 16th St., Brooklyn, N. Y.	.5
2APH	Kalbach, Charles	2211 Andrews Ave., New York, N. Y.	.5
2AOH	Kleppe, Arthur	189 Inwood Ave., Montclair, N. J.	.5
2APQ	Knight, Harold E. H.	251 Fenimore St., Brooklyn, N. Y.	.5
2AQE	Langan, Daniel J.	513 16th St., Brooklyn, N. Y.	.5
2APJ	Lauterborn, George E.	68 N. Lark St., Albany, N. Y.	.5
2KG	Layng, Grant	841 St. Nicholas Ave., New York, N. Y.	.5
2AQL	Love, John H.	Barron Ave., High School Building, Woodbridge N. J.	.5
2AQH	Palmer, Thos.	18 Fulton St., Newark, N. J.	.5
2AQE	Phelps, Charles H., Jr.	459 W. 140th St., New York, N. Y.	.5
2APM	Purvis, Harry	500 W. 173d St., New York, N. Y.	.5
2APP	Prinz, Peter J.	28 Hanson Pl., Jamaica, N. Y.	.5
2APK	Schedler, Herbert D.	1024 Summit Ave., Jersey City, N.J.	.5
2AQG	Scott, Walter F.	207 N. 11th St., Newark, N. J.	.5
2APD	Skinner, Wm.	Ridgewood Ave. and Spruce St., Richmond Hill, N. Y.	.5
2AQI	Smejkal, Harry	1349 1st Ave., New York, N. Y.	.5
2APO	Tyler, Burnett	79 Winthrop St., Brooklyn, N. Y.	.5
2APL	Urban, Charles B.	113 Washington St., Westfield, N.J.	.5
2APS	Wiendieck, Elmer C.	Merrick, N. Y.	.5
2API	Williams, E. Harvey	547 Clifton Ave., Newark, N. J.	.5
2APT	Woodman, Malcolm W.	New York University, New York, N. Y.	.5
2APF	Woolley, Harrison	569 W. 173d St., New York, N. Y.	.5

THIRD DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
3CK	Baer, Francis M.	1744 Corcoran St., N. W., Washington, D. C.	.5
3ATI	Bayne, C. Armistead	14 Moran Ave., Norfolk Va.	1
3DN	Bertolet, Benjamin, Jr.	2112 Columbia Ave., Philadelphia, Pa.	.5
3CQ	Finger, Russell W.	448 Royden St., Camden, N. J.	.5
3ATH	George, John R.	5150 Knox St., Philadelphia, Pa.	.5
3AFK	Lohr, Allen W.	2122 Flagler Pl., N. W., Washington, D. C.	.5
3DJ	McCarter, Wm. F.	4718 N. Camac St., Philadelphia, Pa.	.5
3AER	Weber, James N.	111 3d St., Milville, N. J.	.5

FOURTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
4DV	Nelson, Wayne M.	Kernersville, N. C.	.5
4DW	Swinson, Alton H.	Little River, Fla.	.5

FIFTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
5DE	Ernest, Walter C., Jr.	119 St. Stevens Ave., Mobile, Ala.	.5
5EK	Hirsh, Leon	911 Fremont Ave., Muskogee, Okla.	.5

FIFTH DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
5CU	Miller, Harold L.	1012 Government St., Mobile, Ala.	.5
5EL	Smith, Leo H.	3161 Fetzer St., Shreveport, La.	.5

SIXTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
6VL	Bell, Oran M.	453 Isabel St., Los Angeles Cal.	.5
6KC	Bolton, Herbert J.	417 Park View St., Los Angeles, Cal.	.5
6OH	Bonham, Carlton L.	R. F. D. No. 1, Linden, Cal.	.5
6WP	Brown, Norman C.	Reno Power House, Reno, Nev.	1
6CC	Canfield, Carleton E.	169 High St., Santa Cruz, Cal.	.5
6VN	Carter, Robert F.	101 Ralston St., Reno, Nev.	.5
6TZ	Christenson, Howard	426 Palm Ave., Burbank, Cal.	.5
6DI	Cookson, Howard A.	361 14th Ave., San Francisco, Cal.	1
6DA	Davis, Clarence	909 W. Walnut St., Santa Ana, Cal.	.5
6FN	Deetkin, Frederick, I.	1535 6th St., Alameda, Cal.	.5
6AD	Diamond, Alfred	2015-A Sacramento St., San Francisco, Cal.	.5
6WH	Fabling, Walter D.	3624 2d Ave., Los Angeles, Cal.	.5
6AT	Heer, Alphonsus A., Jr.	134 Marsh Ave., Reno, Nev.	.5
6TE	Hueter, Noble G.	1434 Jones St., San Francisco, Cal.	.5
6VY	Kreiss, Rudolph L.	1062 Stannage Ave., Berkeley, Cal.	1
6LF	Lohry, Ross B.	1932 Irving Ave., East Oakland, Cal.	1
6CA	Lowell, Charles H., Jr.	1403 Martel Ave., Los Angeles, Cal.	.5
6EN	Miller, Elmer	1346 La Brea St., Los Angeles, Cal.	.5
6WM	Ludlow, Wm. B.	2320 Cedar St., Berkeley, Cal.	.5
6LA	Parker, Ralph	Lockeford, Cal.	.5
6LX	Parkin, John, Jr.	22 Terra Dillo Ave., San Rafael, Cal.	1
6OJ	Peterson, Frank E.	2615 Virginia St., Berkeley, Cal.	.5
6EG	Poage, Edward A.	143 15th St., Richmond, Cal.	.5
6UZ	Schellenback, Ray	1223 San Julian St., Los Angeles, Cal.	.5
6TV	Seitel, T. Benton	Chino, Cal.	.5
6CK	Spenser, Edward R.	1640 23d Ave., Oakland, Cal.	1
6ST	Spencer, Howard E.	Rivera, Cal.	.5
6SA	Spencer, Oscar J.	33 Douglas St., San Francisco, Cal.	.5
6JS	Squires, John E.	1605 Arch St., Berkeley, Cal.	.5
6BK	Talbott, Paul H.	740 S. San Antonio Ave., Pomona, Cal.	.5
6QZ	Urban, Carl H.	320 Maple St., Reno, Nev.	.5
6JI	Wagnon, Earl B.	Los Altos, Cal.	.5
6JV	Worthington, Jack	548 37th St., Oakland, Cal.	.5
6TY	York, Darwin E., & Guy A.	1001 W. 1st St., Santa Ana, Cal.	.5

SEVENTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
7DB	Bolstad, Archie L.	1832 4th Ave., W., Seattle, Wash.	.5
7QF	Chaffee, Arthur L.	3637 Woodland Park Ave., Seattle, Wash.	.5
7NC	Clodfelter, Nolan A.	1221 E. Madison St., Portland Ore.	.5
7SD	Schurch, Edward C.	Deer Lodge, Mont.	.5
7SJ	Stewart, Gleen R.	111 W. 8th St., Ellensburg, Wash.	1

EIGHTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
8AKC	Bain, Ovid	1731 E. Center St., Marion, Ohio	.5
8ACT	Baumgardner, Donald G.	Demster, N. Y.	.5
8IY	Bidwell, Paul	9990 Euclid Ave., Cleveland, Ohio (has 2 stations)	1 1
8WP	Bidwell, Paul	11397 Glenwood Ave., Cleveland, Ohio	.5
8AAJ	Brice, Wm. E.	714 W. Market St., Lima, Ohio	.5
8NY	Brown, Fred C.	Port Clinton, Ohio	1
8VZ	Burchard, Wm. K.	77 Hastings Ave., East Cleveland, Ohio	.5
8AGM	Burtis, Melvin M.	191 Goulding Ave., Buffalo, N. Y.	1
8WO	Bush, Richard A.	255 Main St., Binghamton, N. Y.	1
8AAP	Brown, Stanley E.	1 Aurora St., Lancaster, N. Y.	.5
8AIY	Carroll, Stanley W.	312 2d St., Marietta, Ohio	.5
8ABG	Caswell, Frank A.	21 Dekalb St., Dayton, Ohio	.5
8AIL	Conrad, Mark	117 East Crawford St., Van Wert, Ohio	1
8AGC	Donahue, James B.	Horseheads, N. Y.	.5
8ADZ	Euler, John F.	253 Mellon St., Pittsburgh, Pa.	.5
8NC	French, Samuel W.	10 Fargo Ave., Ashtabula, Ohio	.5
8WD	Fox, Edmund H.	271 Calumet Ave., Detroit, Mich.	.5
8WY	Hardesty, Howard P.	1186 Canton Ave., Detroit, Mich.	.5
8OO	Hummel, Richard O.	1606 Grace Ave., Lakewood, Ohio.	.5
8ADH	Lee, Harry H.	Memphis, Mich.	.5
8AEN	Manning, Stuart M.	527 Mitchell St., Petoskey, Mich.	.5
8UE	Motz, Leo	St. Augustine's School, Cincinnati, Ohio	1
8AKB	Pickens, Willard H.	209 Hazelwood Ave., Ensworth, Pa.	1
8AFK	Robertson, Adelbert R.	7938 Tioga St., Pittsburgh, Pa.	1
8AAF	Robinson, David L.	513 Freeport Rd., New Kensington, Pa.	.5
8WM	Slocum, Charles	170 Annadale Ave., Akron, Ohio	.5
8AKD	Staunton, R. E.	587 Dewey Ave., Rochester, N. Y.	.5
8ABI	Stellwagen, Arthur	312 E. Jefferson St., Ann Arbor, Mich.	.5
8AIP	Tatman, Harley C.	Continental, Ohio	.5

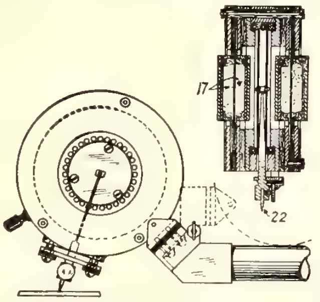
(*To be continued.*)

LATEST PATENTS

Microphonic Reproducer for Phonographs

(No. 1,185,877; issued to John J. Comer.)

Clever design of double microphonic reproducer and telephonic transmitter for talking machines.

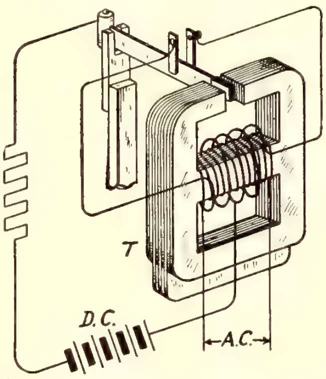


Needle 22 rests on disc record, while sound vibrations set up by central diaphragms react acoustically on two microphones 17, 17. Diaphragms are specially mounted in felt, etc., to prevent extraneous sounds from affecting them. This microphonic translator is now used with 110 volt current and yields excellent results.

Vibrating A. C. Rectifier

(No. 1,888,157; issued to John T. Dempster.)

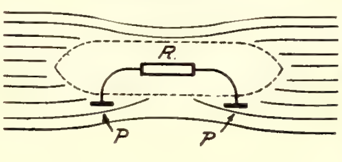
The combination in A.C. to D.C. rectifying apparatus of a trans-

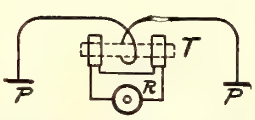


former having a closed main path for the magnetic flux and a shunt path for the magnetic flux having an air gap therein, the two paths being coincident only in the portions covered by the transformer windings, and a movable armature having a free end located in the gap so as to be actuated by the alternating magnetic flux set up in the shunt path as seen.

Submarine Telegraphy Scheme

(No. 1,190,156; issued to Walter Hahnemann.)



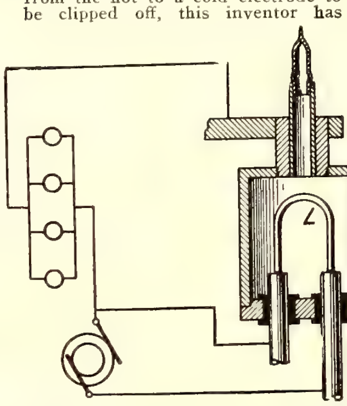


An improved method of carrying on telegraphic and telephonic communication by conduction through water to vessels, etc. Two metal plates, submerged, and near a metal hull, will not pick up sufficient current to work an ordinary receptor, as they are "shunted" by the hull. If the receiving circuit, however, is made to have a very low resistance by utilizing a step-up transformer with a one-turn primary, which "turn" is part of a heavy wire joining the submerged plates, then good results can be obtained, the inventor states. A telephone receiver may be placed in the multi-turn secondary circuit.

Alternating Current Rectifier

(No. 1,189,738; issued to Owen W. Richardson.)

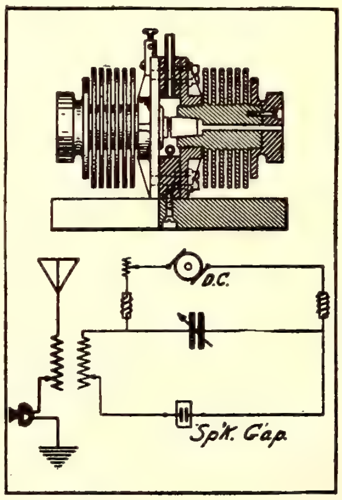
On the theory that an incandescent body emits large quantities of negative electrons, and thus causes half pulses of an A.C. passing from the hot to a cold electrode to be clipped off, this inventor has



evolved a rectifier for changing A.C. into D.C. The heated filament is enclosed in an evacuated metal chamber, which may contain hydrogen. The filament when coated with lime possesses a greatly enhanced ability for emitting electrons. A negative pulse can pass from the hot filament to the cold cylinder but not vice versa.

Quenched Gap Radio System

(No. 1,189,791; issued to Emory Leon Chaffee.)

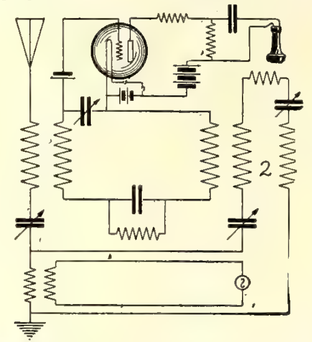


A new form of quenched spark or arc gap designed for use on direct current circuits in the manner here shown. The metal sparking electrodes are held by large ribbed, ventilating members for cooling. The gap proper is air-tight and may be saturated with hydrogen gas through tubes indicated. This gap is adapted to produce extremely high frequency oscillations suitable for radio-telephony. Undamped oscillations have been obtained with it having a wave length of 20 meters, or a frequency of 15,000,000 cycles per second.

Duplex Wireless System

(No. 1,188,531; issued to John R. Carson.)

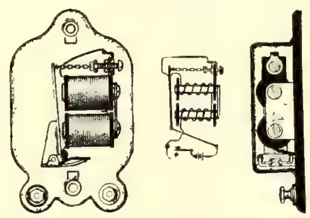
A duplex wireless system based on the fact that two resonant frequencies or wave lengths are employed for the simultaneous trans-



mission and reception of radio messages, to one of which the transmitting system proper is tuned, and to the other of which the receiving system proper is tuned. The receiving system is carefully screened from electromagnetic induction emanating from the transmitting system. Auxiliary branch circuit 2 gives the system two resonant wave lengths. Detector cannot be "killed" by heavy transmitting current as coupling coils act differentially in such an event.

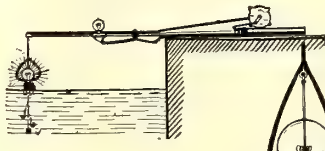
Electric Buzzer

(No. 1,190,608; issued to Richard I. Utter.)



The inventor of this simple electric buzzer claims that by utilizing a fine link chain as indicated for creating a variable resistance in the circuit that he eliminates expensive contacts, and, moreover, that this buzzer is extremely simple in construction; most positive in operation and less likely to get out of order. These claims seem rather dubious.

Electric Fish-Pole

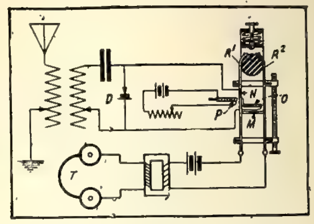


(No. 1,190,872; issued to Forest E. Dildine.)

An electric fishing pole for the angler, providing an electric lamp on the float, also one on the pole. These are controlled by the fisherman and supplied with current from a small battery. A twin conductor feeds the lamps. The float is so constructed that a twine connection carrying the usual hooks, etc., may be attached to its underside, and arranged so that the length of twine may be adjusted as desired. A novel wrinkle for those who fish at night. You can't miss the float when it "bobs."

Radio Relay

(No. 1,189,881; issued to Frederick G. Simpson.)

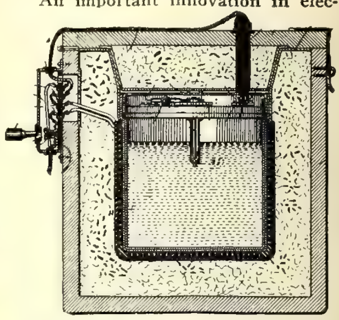


A tuned microphonic relay for receiving radio-telegraphic signals. An ordinary circuit is used to tune to the wave length; a crystal or other detector sends rectified impulses into coils N and O. Two tuned reeds R_1 and R_2 are vibrated by the A.C. field from N and O, acting in a D.C. magnetic field from coil P. A microphone M controls a transformer primary circuit as seen, the secondary circuit actuating the head 'phones T. When tuned the reeds of the microphone M respond to a certain group frequency only. They can be tuned by an adjusting screw.

Electrical Cooker

(No. 1,188,734; issued to Edward E. Clement.)

An important innovation in elec-

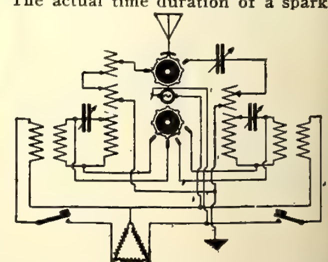


trical cookers of the "fireless cooker" type, using either inbuilt electric heating elements or removable heaters. Also timing and and temperature cut-off attachments by which the current supply will be cut off when the temperature has reached a certain, predetermined value, or after the victuals have cooked for a certain length of time. Heat proof linings are used as in the fireless cooker with a consequent high efficiency.

Multiplex Radio Scheme

(No. 1,189,070; issued to Burr V. Deitz.)

A multiplex radio transmitting scheme providing a system whereby two or more messages or signals can be transmitted from a common aerial system or apparatus with relatively high efficiency and without interference between the messages or signals. A common alternator carries synchronous rotary spark gaps, one of which discharges in the time interval during which the other gap is dead. The actual time duration of a spark



is relatively very short, as is well known. More transmitting circuits can be used with the common aerial as desired, utilizing of course a suitable spacing and positioning of the gap electrodes.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 !! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

No. $\dfrac{+23-24}{\dfrac{H_2SO_4}{\sqrt{00001}\frac{17}{16}}}$

FELIX DOMESTICA OF CATAPILLA, CONNECTICAT
CATSTATIC GENERATOR

Spifilication of Patent Postals **Patent Aplitefor**

To Whoom it Might Conserve:

Be it knowed that I, Felix Domestica, of the city of Catapilla, in the state of Connecticat, have constructed, invented, and otherwise created certain useful improvements on domesticated felines, which will have the most revolutionary consequences on the world's supply of electricity.

It is an uncontrovertible fact, already propounded by the Egyptians, that outside of being musical, especially at nights, cats do not in any wise lighten the burden of man. They perform no useful work, but prefer to live on the rat of the land. Statistics also show that could we extract all of the inherent as well as inherited free electricity from all of the living cats, kittens and pussycats, we would obtain enough energy to run all the electric street cars in this country for 26 hours, 12 minutes and 64 seconds.

It has remained to your petitioner to develop a machine which at once lifts all the cats from the unproductive class into the beloved sweatshop class. No longer need valuable energy be lost, no longer need cats practice nocturnal *cat*aphonics, producing *cat*aclysms in *cat*acombs, resulting in *cat*aplexy of the listeners and in subsequent *cat*aracts of *cat*chup bottles with attending *cat*astrophies.

While there are a myriad of uses to which the liberated catelectricity can be profitably employed, the accompanying specification shows only one application, namely the supplanting of the physician's static machine, by means of my new Catstatic Generator.

In elucidating the automatic action of this apparatus the petitioner presupposes that one of the slumber destroyers has already been obtained. First rod (1), sliding in a hole in the center of a door at the end of the narrow cage, is pulled out until block (2) carrying pin (3) prevents further motion. Then the door is opened and the credulous cat is introduced and adjusted to the best lines of commutation by an arrangement which, like the rest of the machine, is very simple. The rod (1) is slowly but firmly pushed forward until the *motive power* has been urged about half way up the inclined plane formed by the endless belt (4) and is secured at that point by a set screw provided for that purpose so that the feline may be instantly invigorated whenever it slackens its pace.

The competent kitty, incited by the saucer of milk ahead as well as by the point of the prodding pin behind, endeavors to move forward and in so doing causes the belt (4) to move in the opposite direction. This motion is transmitted by means of pulley (5) and belt (6) to pulley (7), thus causing the hard rubber combs, fastened at regular intervals on belt (8), to pass through the cat's fur and in this way obtain a negative (—) charge of electricity. As each comb passes collector (9) it gives up this charge, which is then conducted to Leyden jar (10). Likewise the positive (+) charges, which appear simultaneously with the negative ones, pass through the body of the cat to the brass strips attached on belt (4), are carried by them to collector (11) and are finally stored in Leyden jar (12). As soon as the potential becomes sufficiently great, sparks will jump across gap (13).

What I claim is: 1° A cat operates static generator producing *cat*electricity, eliminating *cat*acoustics as well as *cat*alepsy in a *cat*egorical manner in *cat*tle as well as in humans.

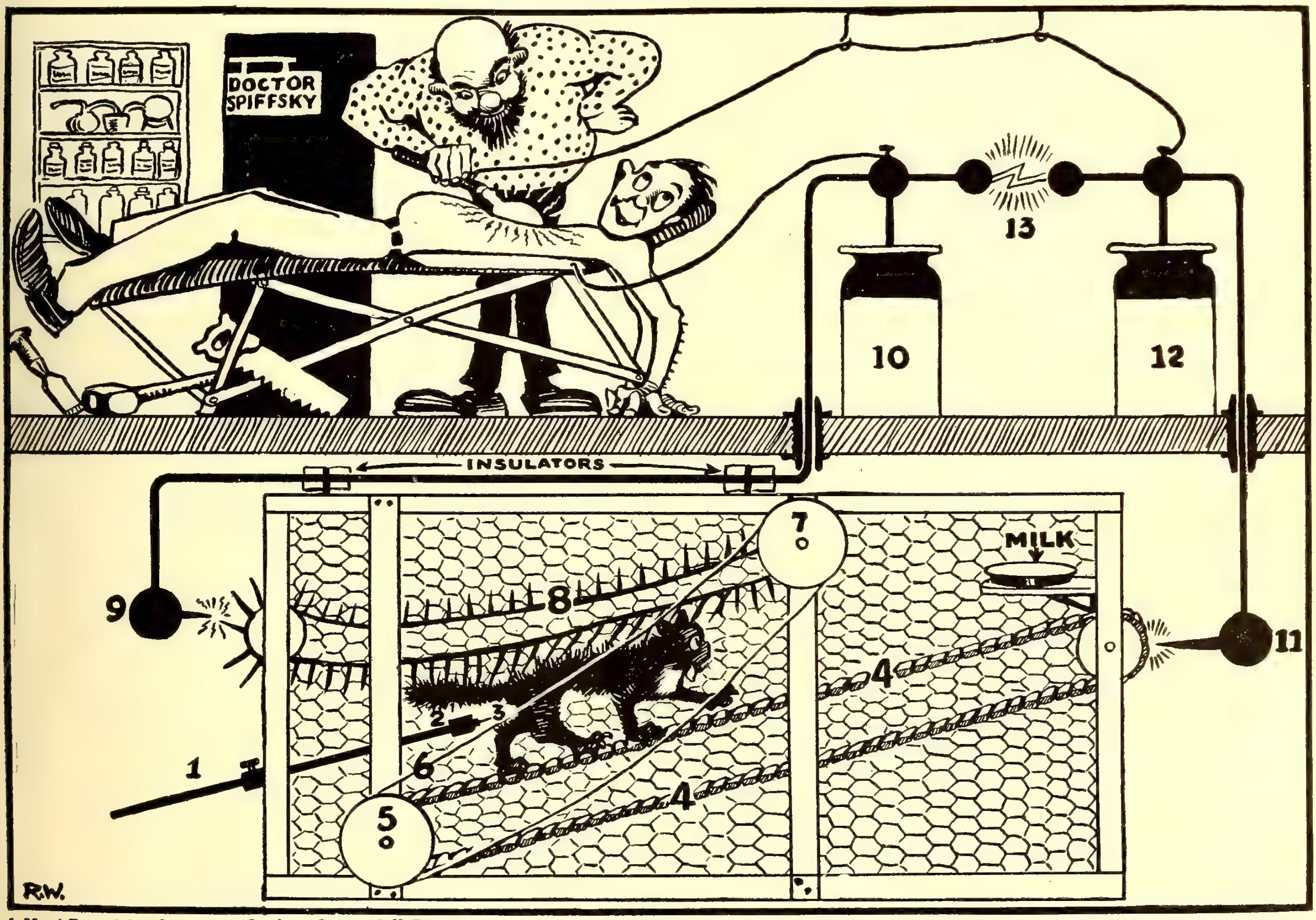
In testimony whereof, in the presence of taxicab tormentors, I affectionately affix my superannuated striped suspenders, this April Fool's Day in the twenty-third year after the advent of the "Ford."

(Signed) Felix Domestica.

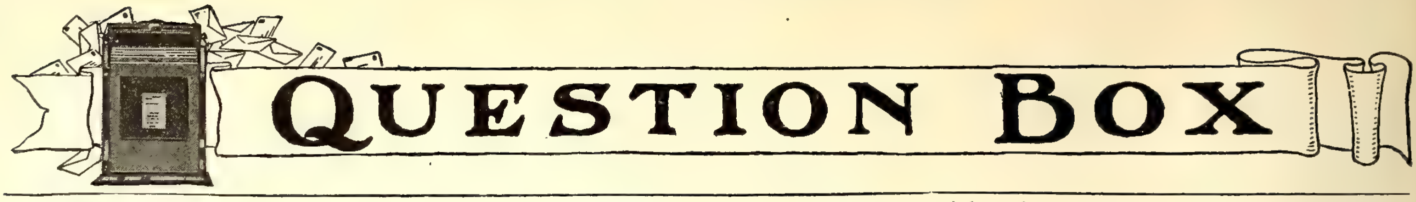
By his attorney, John M. Downie.
Brainerd, Minn.

Witnesses:

Watchu Handinus.
I. M. Pickelt.
Kwityer Kidden.



A Most Promising Invention Is the "Catstatic" Generator. It Accumulates the Electrical Energy from Otherwise Useless Felines and Delivers It to the Physician's Gouty Instrument as Here Shown and Set Forth.



This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

MOTOR QUERIES.

(624.) P. Muldrid, Spokane, Wash., wishes to know:

Q. 1. How can one tell the amount of power developed by a motor when it is in regular service, driving machinery?

A. 1. If the motor can be disconnected from the regular load and a brake applied, the efficiency may be determined for dif ferent currents. Then by measuring the current and voltage while it is working under its regular load, and multiplying by the efficiency of the motor for such a load, we can determine the power being delivered.

Q. 2. Does the resistance of the armature have much to do with the amount the speed slows down?

A. 2. The less the resistance of the armature, the more nearly the counter electromotive-force equals the line voltage, and the less reduction of C.E.M.F. necessary to allow the greater current to pass. Hence the speed of the motor will be more constant for varying loads as the resistance of the armature is less.

Q. 3. How can the counter electro-motive force be measured?

A. 3. It cannot be measured directly. It can be calculated by taking the difference between the total pressure at the terminals of the armature and the product of armature current by the measured resistance of the armature.

RHEOSTAT.

(625.) John Golby, Richmond, Va., asks the following questions:

Q. 1. For what purpose are rheostats used?

A. 1. They are connected into the field magnetizing circuits of dynamos to regulate the electromotive force of the generator; they are used in series with motors to make them start slowly. Rheostats are sometimes used to vary the difference of potential between the terminals of apparatus connected to constant potential circuits.

Q. 2. How much energy may be dissipated in a water rheostat?

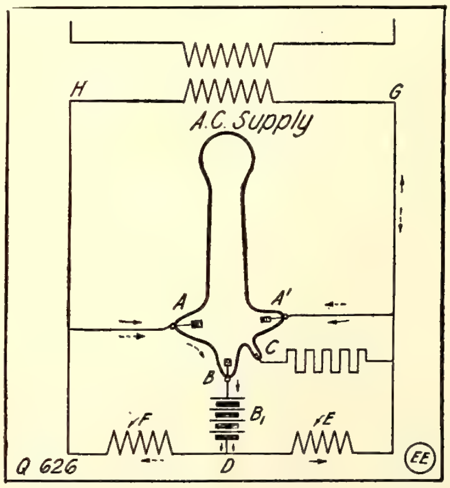
A. 2. In general the current density should not exceed 1 ampere per square inch of electrode. Pure water is rarely used for the solution for potentials below 1000 volts. For these lower potentials sulphuric acid (use lead or carbon plates in the acid solution) or common salt (iron plates commonly used for salt solution) is added to the electrolyte to render it more conductive. It has been found that the radiation capacity of a liquid rheostat depends upon its volume and not upon the area of the exposed surface. It is usual to compute the capacity of a water rheostat on the basis of watts per cubic inches. A good rule is to consider 500 to 800 cubic inches of solution for every 746 watts (1-H.P.) to be absorbed continuously. For starting motors about 20 cubic inches per H.P. capacity may be allowed. Mr. H. W. W. Dix gives average values for watts per cubic inch as follows: for 30 degrees C. rise in temp., 1 watt per cu. in.; for 48 degrees C. rise in temp., 2 watts per cu. in.; for 60 degrees C. rise in temp., 3 watts per cu. in.; and for 67 degrees C. rise in temp., 4 watts per cu. in. By allowing cold water to circulate through the tank or barrel much higher current densities can be used. It requires $\frac{86.5}{t}$ kilograms or $\frac{190}{t}$ pounds of water per hour to dissipate the heat liberated by the absorption of one kilowatt with a temperature rise of "t" degrees centigrade. This rule applies also to the cooling of metallic resistors submerged in running water.

MERCURY RECTIFIER.

(626. S. Dantheury, Chicago, Ill., wants to know the following:

Q. 1. A description of the operation of a mercury arc rectifier.

A. 1. The accompanying diagram is an elementary diagram of connections. The rectifier tube is an exhausted glass vessel in which are two graphite anodes AA and one cathode B. The small starting electrode C, is connected to one side of the alternating circuit through a resistance, and by rocking the tube a slight arc is formed which starts the operation of the rectifier bulb. At the instant the terminal H of



Circuits and Current Paths in Mercury Arc Rectifier. B_1 May be a Storage Battery Under Charge.

the supply is positive, the anode A is then positive and the arc is free to flow between A and B. Following the direction of the arrow still further, the current passes through the battery B_1, then one half of the main reactance coil E, and back to the negative terminal G of the transformer.

When the impressed voltage falls below a value sufficient to maintain the arc against the reverse voltage of the arc and load, the reactance E, which heretofore has been charging, now discharges, the discharge current being in the same direction as formerly. This serves to maintain the arc in the rectifier tube until the voltage of the supply has passed through zero, reversed, and built up such a value as to cause the anode A, to have a sufficient positive value to start the arc between it and the cathode B. The discharge circuit of the reactance coil E is now through the arc A. B is now supplied with current, partly from the transformer as indicated by the dotted line arrows.

ELECTROSTATIC INSTRUMENTS.

(627.) L. Pontpies, Seattle. Wash., inquires:

Q. 1. What is the operating principle of electrostatic instruments?

A. 1. The action of these instruments depends upon the fact that two conductors attract one another when any difference of electric pressure exists between them. If one be delicately suspended so as to be free to move, it will approach the other, providing the charges are of opposite polarity.

Q. 2. Describe the Kelvin electrostatic voltmeter.

A. 2. A simple form consists of a metal case containing a pair of highly insulated plates, between which a delicately mounted, paddle-shaped needle is free to move. When the needle is connected to one side of a circuit and the stationary plates to the other side, the needle is attracted and moves between them, the magnitude of the movement depending upon the amount of charge present.

DYNAMO QUERIES.

(628.) Frank Smith, Washington, D.C., asks:

Q. 1. How should a shunt or compound dynamo be started?

A. 1. All switches controlling the external circuits should be opened as the machine excites best when this is the case. If the machine be provided with a rheostat or hand regulator and resistance coil, these latter should all be cut out of the circuit or short-circuited until the machine excites, when they can be gradually cut in as the voltage rises. When the machine is giving the correct voltage as indicated by the voltmeter or pilot lamp, the machine may be switched into connection with the external circuit.

Q. 2. If a shunt generator will not pick up, what is likely to be the trouble?

A. 2. The speed may be too slow; the resistance of the external circuit may be too small; the brushes may not be in proper position; some of the electrical connections in the dynamo may be loose, broken or improperly made; the field may have lost its residual magnetism.

Q. 3. What is the indication that the connections between the field coils and armature are reversed?

A. 3. If the machine builds up when

(Continued on page 434)

QUESTION BOX.

(*Continued from page 432*)

brought to full speed, the connections are correct, but if it fails to build up, the field coils may be improperly connected.

POLARIZATION IN BATTERY CELLS.

(629.) Paul Jones, Boston, Mass., asks:

Q. 1. How a primary battery is depolarized?

A. 1. A *depolarizer* is used as a rule to unite chemically with the gas, and form a substance that will dissolve in the liquid. For this purpose black oxide of manganese, oxide of copper, red lead, peroxide of lead, sulphur, bromine, chlorin, nitric acid and solutions of chromic acid, or bichromate of soda, and other similar oxidizing agents are employed. Some of these attack zinc, even when the circuit is open, and must be used with great care. The solid depolarizers generally work quite slowly and are used in cells for intermittent work on circuits that are generally open. Liquid depolarizers generally work rapidly and the cell may be used continually with but little diminution of the E.M.F.

Q. 2. What type of cells employ liquid depolarizers?

A. 2. These may be divided into two classes; those with single liquids and those with two. The former class is represented by the bichromate cells, the latter by the Bunsen batteries.

ELECTRO-CHEMICAL EQUIVALENT.

(630.) John Peterson, Baltimore, Md., wishes to know:

Q. 1. What is meant by the *electro-chemical equivalent?*

A. 1. The electro-chemical equivalent of an element is the amount liberated by one coulomb. Experiments show that one coulomb (1 ampere flowing for one second) will liberate .000010384 grams of hydrogen gas from water or other compounds. As hydrogen is the lightest element known, its weight is taken as unity for the basis of comparing the weight of atoms of other elements. The various elements are also classified according to their *valency* or the power they have in uniting with other elements. Thus one atom of oxygen will unite with two atoms of hydrogen to form one molecule of water; thus oxygen is said to have a valency of two and hydrogen one, while other elements have a valency ranging from 1 to 6. The electro-chemical equivalent of an element is therefore the atomic weight multiplied by .000010384 and divided by the valency. A simple expression for determining the value is

$$E = \frac{Aw}{V} \times .000010384$$

where
E=electro-chemical equivalent
Aw=atomic weight
V=valency

MAGNETIC QUERY.

(631.) Richard Johnston, Queens, N.Y., inquires:

Q. 1. What determines the number of ampere-turns necessary to magnetize a circuit to a desired intensity?

A. 1. This is determined by the length and area of the various parts of the circuit and by the permeability of each part, using the general equation:

$$\text{Magnetization} = \frac{\text{Magnetomotive force}}{\text{Reluctance}}$$

The development of the above expression is:

$$\Phi = \frac{\frac{4\pi NI}{10}}{\frac{1}{Au}} = \frac{1.257\ NIAu}{1};$$

Where: Φ=number of lines of force,
N=number of turns of wire,
A=area of the section of the magnetic circuit,
l=its length,
u=permeability of the iron.

In solving the equation in terms of N, so that it may be convenient in obtaining the number of ampere-turns, we get:

$$NI = \frac{l\,\Phi}{1.257\,Au}$$

This expression is given in C.G.S. units and if inches are used instead of centimeters the expression becomes

$$NI = \frac{\Phi l''}{A''u} \times .3132$$

If the magnetic circuit is uniform, the ampere-turns may be calculated directly from the above formula. If there are a number of unlike parts, the magneto-motive force (M.M.F.) for each part may be calculated and the sum of these gives the total number of ampere-turns.

RELUCTANCE.

(632.) L. Zehnder, Middletown, N.Y., wants to know:

Q. 1. What is meant by *reluctance?*

A. 1. The magnetic pressure (magneto-motive-force) acting in a magnetic circuit encounters a certain opposition to the production of a magnetic field, just as an electro-motive-force in an electric circuit encounters opposition to the production of a current. In the magnetic circuit the opposition is called reluctance; it is simply magnetic resistance and may be defined as the resistance offered to magnetic flux by the substance magnetized. It is the ratio of the magneto-motive-force to the magnetic flux.

Q. 2. Upon what does the reluctance of a magnetic circuit depend?

A. 2. The reluctance is directly proportional to the length of the circuit and inversely proportional to its cross-sectional area.

Q. 3. Does the reluctance depend upon the quality of iron used in the magnetic circuit?

A. 3. Yes.

CONDENSER CAPACITY.

(633.) Theo. S. Brown, Quincy, Mass., writes for:

Q. 1. The dimensions of an antenna series condenser that will reduce the wave length of a three wire aerial, 183 feet long and 35 feet high down to 200 meters?

A. 1. You need a condenser having a maximum capacity of .0164 mfd. It is not practical to make such a large reduction in wave length in this way.

KICK-BACK PREVENTERS.

(634.) Earl Henson, Philadelphia, Pa., writes:

Q. 1. Do you lower or increase the capacity by connecting two condensers in series? If so, in what proportion to the first capacity of each? If two .003 m.f. condensers are used in this manner, what is the combined capacity?

A. 1. You lower the total capacity of a group of condensers which are connected in series. The capacity is one over the reciprocal of the sum of the capacities of the individual condensers. The capacity of the combined condenser is .0015 m.f.

Q. 2. Which side of the meter, i.e., the street or the house, do you connect a kick-back preventer? Is this a condenser, resistance, or an inductance?

A. 2. It is connected to regular house mains after the meter. It is nothing more than a high capacity condenser with a micrometer spark gap, although a 10,000 ohm

(*Continued on page 438*)

Radiocite

"USE RADIOCITE IN YOUR DETECTOR AND FORGET IT"

RADIOCITE is the most wonderful of all radio crystals. It is more sensitive than Galena and far more sensitive than ANY other crystal or mineral. RADIOCITE is a specially selected grade of a rare crystal chemically treated by our own secret process.

The mineral that looks like liquid gold. It has a highly, wonderfully polished surface giving it a perfectly burnished appearance. This crystal is now in use by several governments, and is conceded to be the most satisfactory of all. It is used with a medium stiff phosphor bronze spring, or with a stiff silver wire, about No. 30 B. & S. Gauge.

WHAT IT IS

One of the important features of RADIOCITE is that it does not jar out easily. Each crystal is *tested for sensitivity* and guaranteed. RADIOCITE comes packed separately in a box, wrapped in tin-foil. Full directions accompany it.

RADIOCITE can be mounted like any other crystal; it may be clamped between springs, but it is best to set it in *Hugonium* soft metal. Money refunded if our claims are not substantiated.

No. 3939. Generous piece of tested RADIOCITE. **Prepaid, $0.50.**

THE ONE UP-TO-DATE MINERAL WHICH EVERY AMATEUR MUST HAVE

WHAT THEY SAY:

The letters which we publish herewith tell our story far better than we could. Hundreds of enthusiastic testimonials fill our files Read and see what these well-known amateurs from all parts of the country say. Can you afford to be without RADIOCITE?

E. I. Co., N. Y. Lanark, Ill.
My dear Sirs:
Regarding your new detector crystal *Radiocite* wish to advise that I have received the crystal.
I have used and given same a careful test and *am surprised* at the results received with it. I really consider it a better grade of crystal *than any Galena I ever tried*. Although my station includes an Audion Detector, *I much prefer the Radiocite* for amateur work, for it is very easy to keep adjusted; NAA comes clear as a bell. I will be glad to recommend your crystal to anyone.
Yours very truly,
E. H. GIDDINGS
Radio Station 9MK., Lanark, Ill.
Telegraph Operator, C. M. & St. P. Ry.

The E. I. Co., New York, N. Y. Owego, N. Y.
Gentlemen:
I have thoroughly tested your, *Radiocite*, and find it very stable *withstanding very severe static* and holding a very sensitive adjustment for several days without touching on a table subjected to considerable jarring. Another detector setting beside it would not hold its adjustment but for a short time. It is easy to adjust, and of the several kinds of minerals used by me I consider it the most sensitive. I would recommend *Radiocite* to all amateurs and others who desire a detector easily adjusted, very sensitive, and one which will hold its *adjustment indefinitely and stay sensitive.*
Yours respectfully,
H. G. SMITH.

E. I. Co., N. Y. Littleton, Mass.
Dear Sirs:
That *Radiocite* crystal is one of the best I have used. The first time I tried it stations came in great, some I had never heard before. I hear N.A.A. so loud that I can lay the phones on the desk and hear them. Very truly yours, JACK HARDY

St. Paul's M. E. Parsonage,
E. I. Co., N. Y. Penn's Grove, N. J.
Dear Sirs:
I received my *Radiocite* O. K. and have had splendid results with it. It brought in signals clearer than *Galena* or other minerals I have used. I think it will please everybody.
WM. OGBURN LYNCH

E. I. Co., N. Y. Le Roy, N. Y.
Dear Sirs: June 21st
I have thoroughly tested the *Radiocite* which I received from you and find it far superior in all respects to *Galena, Silicon* or any other mineral I have ever used.
Respectfully yours,
WM. N. TOWNER

E. I. Co., N. Y. 729 Euclid Ave.,
Dear Sirs: Baltimore, Md.
I could not express my satisfaction with the new mineral *Radiocite. It is more sensitive than any crystal detector* I have ever tried. It is also permanently sensitive and *is not knocked out by the ½ K. W. open core transformer* which I use for sending. I remain your true friend,
W. J. POHLMAN

404 Mt. Prospect Ave.,
E. I. Co., N. Y. Newark, N. J.
My dear Sirs:
I received your tested *Radiocite* and find it excellent. As soon as I received it, I put it in the cup, put the detector spring on and N.A.H. came in so loud he could be read *sixteen feet from the phones.*
Yours truly, HENRY D. WILSON, Jr.

Electro Importing Co.,
236 Fulton Street, New York City.
On your absolute guarantee that RADIOCITE is exactly as described by you, I enclose herewith 50 cents in ....for which you are to send me *prepaid* one box containing a generous piece of *tested Radiocite*. You accept my money with the understanding that you will refund it to me at once, should I find the RADIOCITE unsatisfactory. *You guarantee to ship within twenty-four hours or return my remittance.*
Name..................................
Address..................................
State.................................. E.E.10

IMMEDIATE SHIPMENTS. NO DELAY

Electro Importing Co.,
236 Fulton St.,N.Y.

QUESTION BOX.

(*Continued from page 435*)

carbon rod, connected across line, and grounded in the middle, is sometimes used.

INDUCTANCE COIL.

(635.) Gilbert Styler, Bellevue, Pa., wants to know:

Q. 1. Would an aerial 90 ft. high and 300 ft. long with three wires spaced 2 ft. apart be suitable for receiving undamped waves at the natural wave length.

A. 1. You should have no trouble in receiving stations emitting both undamped and damped waves, providing the proper instruments are used in the receiving station.

Q. 2. Please give directions for making inductance marked L in Fig. 1, page 254, August issue.

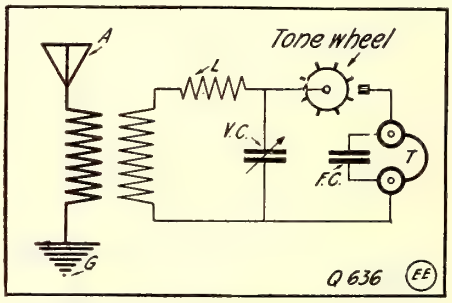
A. 2. The coil L is made by winding a single layer of wire No. 38 gauge upon an insulating tube 18 inches long by 5 inches in diameter. Twenty equal taps are taken from the coil to a multi-point switch so as to regulate the inductance.

METER ENGINEER.

(636.) Chester Shurr, Berthold, N.D., wishes to know:

Q. 1. How to become a Meter Engineer, necessary education, and salary.

A. 1. A meter engineer is practically a full-fledged electrical engineer with a special knowledge of measuring instruments, both in principle and operation. You are advised to consult the September issue of this magazine on page 328 where you can get a fairly good idea as to the educa-



Connection of Tone Wheel in Radio Receiving Set.

tion necessary to become an electrical engineer. An additional course is given in advanced measuring instruments where the student specializes in meter engineering.

As to the salary, it entirely depends upon the man himself. A well versed and experienced meter engineer should have no trouble in making a salary of $1500 per year.

Q. 2. I wish to make a Goldschmidt tone wheel like the one described in a previous issue of *The Electrical Experimenter.* What metal must I use and what must be the size, shape and number of teeth in the wheel to receive Arlington, Sayville and Tuckerton, when using a Knapp type S S Dynamo-Motor run on 4 to 6 dry cells?

A. 2. The rotor of the tone wheel should be made from a steel disc 6" in diameter, with 400 teeth filed on its peripheral face. A small electromagnet is placed on one side of the wheel. The discs should be carefully mounted on the motor shaft and properly secured to same. The connections are given in the diagram. A resistance should be connected in series with the motor and battery so that the speed of the wheel can be regulated in order to receive the distant transmitting station.

ARLINGTON POWER.

(637.) Marvin Fallgatter, Waupaca, Wisc., asks:

Q. 1. Please publish a list of detectors, the most sensitive first and the others following respectively. Please include mineral detectors using different minerals in this list.

A. 1. Vacuum Detectors, Radiocite, perikon, Radioson, galena, silicon, carborundum and molybdenum.

Q. 2. Can iron be used as the lever and contacts of a lightning switch? If so what are the required dimensions?

A. 2. Iron can be used for constructing a lightning switch, but copper is the only material that the Board of Fire Underwriters will pass. However, if you desire to build one, you may use the same dimensions as the one made from copper.

Q. 3. What kilowatt rating and range has Arlington and some of the other government stations?

A. 3. Arlington is rated for 100 kilowatts, Brooklyn 2 to 5 K.W., Boston 10 K.W., Philadelphia 5 K.W., Norfolk 5 K.W., Key West, Fla., 10 to 25 K.W.

ELECTROMAGNET.

(638.) W. T. Saul, Lexington, Mass., inquires:

Q. 1. Can an electromagnet be used on an alternating current? If so, will it not flicker or will it be unperceivable?

A. 1. Yes, it will flicker, and the amount of flickering will depend upon the frequency of current supply.

Q. 2. In an induction coil can a direct current be induced into the secondary without a vibrator or circuit breaker? If so, would you get a direct current?

A. 2. It is impossible to induce a current in the secondary without the use of a vibrator or other form of circuit breaker. It is possible to induce a current in the secondary by supplying the primary with an alternating current and the current obtained from the secondary will be alternating, the periodicity of which will be the same as the primary current.

Q. 3. How can an alternating current be changed to a direct current?

A. 3. By the use of either a chemical, mercury, or mechanical rectifier.

EDISON STORAGE BATTERY.

(639.) Bernard Cohen, Brooklyn, N.Y., writes:

Q. 1. How are the plates of an *Edison* storage battery made? Also where could I get the chemicals and parts for the cell?

A. 1. The positive or nickel plate consists of one or more perforated steel tubes heavily nickel plated, filled with alternate layers of nickel hydroxide and pure metallic nickel in extremely thin flakes. The tube is drawn from a perforated ribbon of steel, nickel plated and reinforced with eight equidistant steel bands, which prevent the tube's expanding away from and breaking contact with its contents. The tubes are flanged at both ends and held in perfect contact with a steel supporting frame or grid made of cold rolled steel also nickel plated. The negative or iron plate consists of a grid of cold rolled steel, holding a number of rectangular pockets filled with powdered iron oxide. These pockets are made up of very finely perforated steel. After the pockets are filled they are inserted in the grid and subject to great pressure between dies which corrugate the surface of the pockets and force them into good contact with the grid. The plates are immersed in an electrolyte consisting of a 21% solution of potash in distilled water with a small per cent of lithia.

We would advise you to communicate with the Edison Storage Battery Co., at Orange, N.J., for material used in the manufacture of their cells. They will undoubtedly quote you a price on the material you desire.

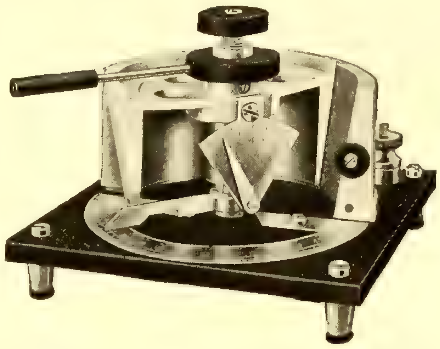
(*Continued on page 440*)

TURNEY TURNEY

The New Turney Vario Variable Condenser Has Seven Scales

10 Days' Trial Allowed

The new TURNEY VARIO VARIABLE CONDENSER is a real innovation in variables. It is seven complete Condensers in one, has seven different scales all of different maximum capacities and approaches an absolute zero heretofore unknown in Condensers. There are no plates to warp, therefore the instrument remains constant. The movable and stationary members are made of a special alloy which in appearance resembles silver and will not tarnish.



DIMENSIONS 6"x6"x3" SHIPPING WEIGHT 2 LBS.

SCALE READINGS

Scale No. 1-0 to .001 M.F. Scale No. 4-0 to .00012 M.F.
Scale No. 2-0 to .0005 " Scale No. 5-0 to .00007 "
Scale No. 3-0 to .00025 " Scale No. 6-0 to .000055 "
Scale No. 7-0 to .000035 M.F.

Price $8.00 POSTAGE EXTRA

10 Days' Trial Allowed

The new TURNEY VARIO VARIABLE CONDENSER is ideal for EXTREME MEASUREMENTS where absolute accuracy is demanded. It is incomparable for WAVE METERS and Regenerative Ionized Gas and pure Electron Detector circuits. The entire instrument (with the exception of the base which is of Bakelite) is engine turned and is made with the greatest care.

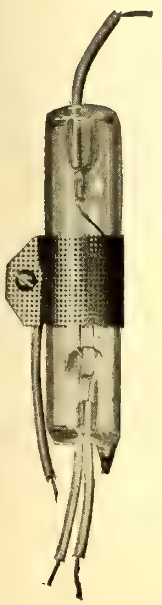
Don't buy a Condenser until you have seen the TURNEY VARIO VARIABLE.

TURNEY TURNEY

EUGENE T. TURNEY CO., Inc., 2595 3rd Ave., New York

The Moorhead Tube

Patent Pending



The MOORHEAD tube must not be confused with the two member valve, as it is inoperative without the outer electrode, or do not class it with the Trons or three member detectors as it is far more sensitive than either, in fact it is the most constant, stable and sensitive detector that has been developed.

A wonderful feature of the Moorhead tube is the static elimination. On the nights when static make the reception of stations with the ordinary detector impossible, the Moorhead tube brings the signals in with a marvelous clearness.

The initial cost of the Moorhead tube is low when the guaranteed long life is considered, and the fact that each Moorhead tube is a guaranteed

DETECTOR, AMPLIFIER and OSCILLATOR

SPECIAL INTRODUCTORY PRICE UNTIL JAN. 1, 1917

$6.50 PREPAID AND DELIVERY GUARANTEED

WE REPLACE ANY DEFECTIVE TUBES WITHOUT QUESTION

Write for circulars on the MOORHEAD tubes and Special sets

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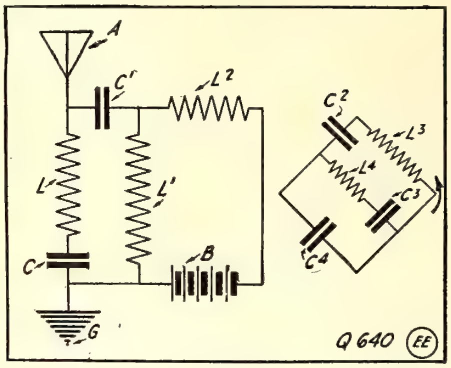
QUESTION BOX.

(*Continued from page 438*)

GOLDSCHMIDT HIGH FREQUENCY ALTERNATOR.

(640.) James Golaby, Paterson, N.J., asks for:



Circuits of the Radio Frequency, Goldschmidt Alternator.

Q. 1. A diagram of a Goldschmidt radio frequency alternator.

A. 1. The diagram here shows schematically the connections of the alternator.

Q. 2. What is the maximum frequency obtained with the present type machine?

A. 2. 40,000 cycles.

Q. 3. What is the clearance between the stator and rotor?

A. 3. About one millimeter.

ELECTRIC HEATING DEVICES.

(641.) A. Trowly, Schenectady, N.Y., wishes:

Q. 1. How much energy is required by electric heating devices?

A. 1. If you refer to 110 volt circuits, a 6½ pound sad-iron for common household use requires 4 amperes, or for laundry use where the work is rushed 5 to 6 amperes; a polishing iron requires 2.5 amperes and an 18 pound goose iron, 5 amperes; 4½ inch plate stove requires 1.9 amperes to make it hot in about two minutes. A larger disc heater 6 inches in diameter takes 5.5 amperes; a single griddle requires the same current, a three section griddle 6 amperes; a chafing dish will take 4 amperes and a small tea kettle 4 amperes to 7 amperes, an immersion coil for cooking food, boiling water or for heating water for special work takes from 4 to 8 amperes, according to the size; a heating pad for application to the body uses only .4 ampere, which is the same current as required for a curling iron. Soldering irons take 1 to 2 amperes, depending also upon the size of the device. The above currents are taken by heating devices on 110 volt circuits. For other voltages the resistances are proportional to absorb an equivalent amount of energy.

Q. 2. How do physicians use electric heat?

A. 2. They use it to some extent for heating poultices and pads to be applied to various parts of the body. They also use it for small incandescent lamps which may be introduced into or near various parts of the body for illuminating purposes and for sterilizing their instruments.

CHOKE COIL.

(642.) Peter Fuller, Chicago, Ill., asks:

Q. 1. What is a choke coil?

A. 1. A choke coil consists of a coil of wire surrounding a laminated iron core. It usually has several terminals so that the number of turns of wire in the circuit may be adjusted, or in some cases part or all of the iron core is movable so as to change the inductance of the circuit. The coil is connected in series with the circuit to be controlled.

Q. 2. For what purpose is a choke coil used?

A. 2. It is used for reducing the voltage and current in the circuit. The self-induction of the choke coil acts as a C.E.M.F. or back voltage opposing the impressed or line voltage and thus reducing the current. For example, a choke coil may be connected in series with a group of incandescent lamps in order to dim them. Choke coils are being used to a considerable extent for maintaining constant current in a series of arc lamps operated from a constant potential alternator; the inductance of the coil being adjusted to compensate any changes of resistance due to the feeding of the arc-lamp carbons.

MULTITONE TRANSMITTER.

(643.) Earl Putnam, Duluth, Mich., wishes:

Q. 1. Diagram of connections of a Lorenz Multitone transmitter.

A. 1. The diagram herewith gives the connections. The second oscillatory circuit CL^4 shunted across the gap, is used for producing the different tones. These are varied by means of a multiple key board; each key is connected to a certain portion of the inductance coil as shown.

Q. 2. Has the decrement anything to do with the oscillation in a 60 cycle transmitter?

A. 2. Yes. It controls the amplitude of each oscillation and also the number of oscillations per group.

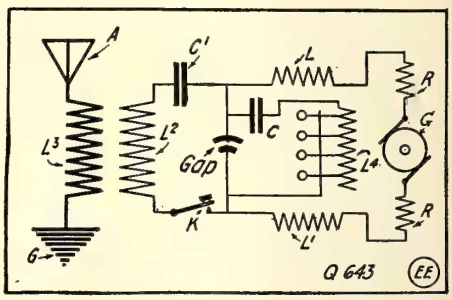
Q. 3. Would like to have an equation showing the relation between current and voltage amplitude in an undamped current of sinusoidal character.

A. 3. The formula for this is:

$$I_o = \frac{V_o}{\sqrt{R^2+(\omega L)^2}};$$

where:

I_o=current in amperes,
V_o=voltage,
R=resistance,
L=self-inductance,
ω=angular velocity.



How Multiple Tones Are Made on the Lorenz Musical Spark Radio Transmitter.

WAVE LENGTH OF ANTENNA.

(644.) J. Edelon, Memphis, Tenn., asks:

Q. 1. What is the wave length of my aerial, composed of four wires 180 feet long, fifty feet high: the lead-in is 24 feet long?

A. 1. The natural wave length of your antenna is 460 meters.

Q. 2. How can a voltmeter be used to measure higher potentials than its ordinary range?

A. 2. The range of a voltmeter is doubled by placing it in series with an equal resistance. For example, if a voltmeter reading 50 volts has a resistance of 20,000 ohms, it will read to 100 volts when in series with an added resistance of 20,000 ohms. This is true only for instruments taking current, and does not hold true for electrostatic instruments. The reason is that an ordinary voltmeter is really a sort of ammeter with a high resistance and if the resistance of the circuit is doubled, twice as much pressure is required to send the same current

(*Continued on page 442*)

QUESTION BOX.

(*Continued from page 440*)

through. By having several resistances, the voltmeter may be given any range desired. Such resistances are called multipliers. If a voltmeter having a scale reading to 100 volts and a resistance of 15,000 ohms is connected in series with a multiplier having 9x15,000 ohms, then its readings should be multiplied by 10.

Q. 3. What precautions are necessary to insure accuracy when measuring resistance with a voltmeter?

A. 3. Be careful that the voltage of the dynamo or battery does not change between the two readings; this can usually be checked by taking a second reading across the line with the voltmeter alone. Be sure also that the voltmeter is not affected by any external magnetic field from the circuit being measured. Also be sure that the wires and connections used do not have any appreciable resistance or the drop in them will have to be considered also.

MOTOR ARMATURE WITH DIAGONAL SLOTS.

(645.) R. Miller, New York City, writes for information:

Q. 1. Concerning what he believes to be an undue magnetic action and end-play, consequent from the use of staggered or diagonal slots on a D. C. motor armature.

A. 1. We do not believe there is any unusual end-thrust produced by this arrangement of the armature slots. You can readily prove this, providing you have a fairly large end-play between the shoulders on the armature shaft and the bearings. Allow the armature to lie either forward or backward from its normal, central polar position, and you will observe that when the field current is suddenly turned on that the armature will immediately center itself, longitudinally, between the pole pieces. The editor of this column has observed this in a number of instances and the staggering of the armature slots not only lowers the *magnetic hum* as you mention but also it allows the armature inductors or wires to enter and leave the magnetic field gradually and not suddenly. It thus causes a much smaller amount of sparking at the commutator brushes. Also the constancy of the turning effort or torque is much higher than in the common form of armature with straight slots, placed parallel to the axis of the armature shaft.

ORIGIN OF THE TERM "ELECTRICITY"

Millions of people of to-day who are living in an electrical age, undoubtedly do not know where the term *electricity* originated, and how people came to use the word universally to signify that power which performs all the myriad wonders that we see daily all about us.

From ἤλεκρτρον (Elektron), the Greek name for *amber,* is derived the word *electricity,* which is now extended to signify not only its power of attracting light bodies when it is agitated by rubbing with silk, fur, etc., but other powers connected with it, in whatever bodies they may be communicated.

The attractive nature of electrified amber is occasionally mentioned by Pliny and other later naturalists; particularly by Gassendus, Kenelm, Digby and Sir Thomas Brown.

Very exhaustive experiments have been carried out by William Gilbert, a native of Colchester, and a physician at London, who, in his excellent Latin treatise "De Magnete," published in the year 1600, relates a great variety of electrical experiments, which were allied in nature to the properties possessed by amber. He has disclosed

(*Continued on page 444*)

Do you wish to subscribe at the present low rate? Before it is too late see page 457.

ORIGIN OF THE TERM "ELECTRICITY."

(*Continued from page 442*)

several of the substances which had these peculiar properties of attracting light bodies when agitated by a material.

Amber was used by the ancient world as a jewel for decoration. Its color and luster reminded the fanciful Greeks of the virgin gold which glistened in the hands of Pactolus; even as the brilliant metal itself had recalled to them the yellow sunshine. Afterwards they applied the same name to the compounds of metals which, when burnished, have a golden glow. They were all children of the sun "Elector"—reflecting in miniature its radiance. Thus in common with native gold and the silver-gold alloys, the amber, in Hellenic speech, came to be called "Elektron."

Dr. Gilbert has found various other substances capable of attracting light bodies when rubbed, similar to the remarkable property of amber, which he called "Electrics." Ever since his time, the name "Electricity" has been employed to denote the characteristic property possessed by these substances and all the other manifestations of a similar nature with which we are all more or less familiar to-day.

THE MEANING OF PH.D., B.SC., AND E. E.

While many of us no doubt are fairly familiar with the abbreviated marks of learning, such as Ph.D., appended to the names of some of the authors contributing articles to the THE ELECTRICAL EXPERIMENTER, a word or two concerning their meaning may not be amiss.

Some of the titles more commonly met with are E.E., M.E., M.A., etc. To elucidate:

E.E. stands for Electrical Expert, but most always infers the rank of Electrical Engineer.

M.E. means Mechanical Engineer or Mining Engineer.

C.E.—Civil Engineer.

Cons. E.—Consulting Engineer.

Ch.E.—Chemical Engineer.

A.E.—Aeronautical Engineer.

R.E.—Radio (Wireless) Engineer, and in naval circles means Radio Electrician.

R.O.—Radio Operator.

T.E. refers to a Telephone Engineer.

S.E. refers to a Sanitary Engineer.

Another class including somewhat more academical degrees is embraced by the following:

B.Sc. infers a Bachelor of Science degree while B.S., though often used to imply the title just cited, really means a Bachelor of Surgery.

M.A. is a Master of Arts.

B.A. or A.B., a Bachelor of Arts.

Ph.D. is equivalent to Doctor of Philosophy.

Ph.B. acts as Bachelor of Philosophy.

D.Sc. and B.Sc., refer respectively to a Doctor and Bachelor of Science.

A professorship degree invariably involves several years post-graduate work, usually at teaching, and is denoted by prefixing to one's name the abbreviation:—Prof. When a person holds several scientific degrees, as a D.Sc. and Prof., it is usual, especially in Europe, to write them thus—Prof. Dr. John Smiley. Several other degrees and titles of everyday vintage are cited below: There is the degree; B. Sc. Arch., meaning a Bachelor of Science in Architecture.

B. or M. of Arch.—Bachelor or Master of Architecture, etc.

M.Sc.—relates to a Master of Science degree.

B.LL. or LL.B., is a Bachelor of Laws.

LL.D.—Doctor of Laws.

M.D.—Doctor of Medicine.
D.D.—Doctor of Divinity.
Ed.—Editor.
Assoc. Ed.—An Associate Editor.
Ass't. Ed.—Assistant Editor.
En'gr.—Engineer.

Members of learned societies use the following appendages:

American Institute of Electrical Engineers—Assoc. A.I.E.E. for associate member, or M.A.I.E.E. for members.

Institute of Radio Engineers—Assoc. I.R.E. or M.I.R.E. for associates and members respectively.

F.R.A.S.—Fellow of the Royal Astronomical Society.

F.R.G.S.—Fellow of the Royal Geographical Society.

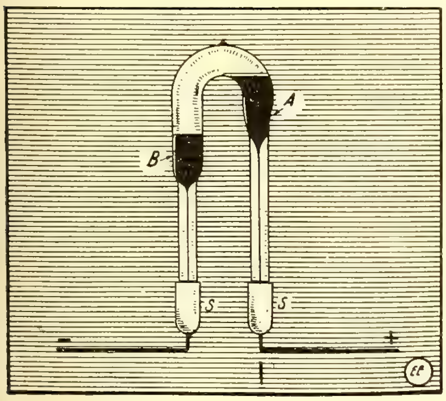
F.R.S.—Fellow of the Royal Society.

English Engineers who are members of the Institute of Electrical Engineers, London, use M.I.E.E. after their names. One of the world's most learned men was the late Silvanus P. Thompson of England. Such scholars as he often have a string of titles trailing off behind their name, beginning with A, and ending in the vicinity of Z. Many of the degrees or titles conferred, however, are honorary ones. Prof. Thompson signed, among other titles, those of D.Sc., B.A., F.R.A.S., F.R.S.

In some cases the college from which the degree was conferred is designated by stating the fact in brackets, thus: James Slocum, Ph.D., (Johns Hopkins University) or simply (Johns Hopkins).

A CADMIUM-VAPOR LAMP.

A new cadmium-vapor lamp has been described in the proceedings of the British Physical Society. Although it is not yet past the experimental stage, the lamp is interesting at this time when so much work is being done on different types of illuminants.



A New Cadmium-Vapor Lamp Suitable for Electric Circuits of 100 to 200 Volts Potential.

This lamp is shaped like an inverted "U" with a long anode chamber and a short cathode chamber. The legs are thick-walled capillary tubes. When started the cadmium is volatilized by means of a Bunsen burner. A voltage of 100 to 200 is used with the lamp, while the current on short circuit is adjusted to 5 amperes by an external resistance. Ordinarily the potential across the terminals is about 30 volts.

AMERICAN INSTITUTE ACTIVE IN PREPAREDNESS PROPAGANDA.

John J. Carty, president of the American Institute of Electrical Engineers, has sent a letter to the membership calling for the co-operation of every member to the end that a careful industrial inventory of this country's manufacturing and producing resources for purposes of national defense may be made.

MINIMUM CHARGES FOR ELECTRICITY IN CITIES OF 250,000 AND OVER.

In testimony before the state public utilities commission of Illinois in the matter of the proposed change of rates for electric service in Chicago there was introduced a statement of the minimum bills in effect in the cities of the United States having a population in excess of 250,000 people. The highest rate is at Buffalo and Baltimore where consumers are required to pay $1.20 a month irrespective of the fact whether they use any current or not. This list is as follows:

New York	0 per month
Omaha	50c per month
Detroit	50c per month
New Orleans	50c per month
Kansas City	50c per month
St. Louis	50c per month
Milwaukee	50c per month
Louisville	50c per month
Pittsburgh	50c per month
Los Angeles	65c per month
Philadelphia	75c per month
San Francisco	75c per month
Cleveland	$1 per month
Brooklyn	$1 per month
Minneapolis	$1 per month
Washington	$1 per month
Newark	$1 per month
Jersey City	$1 per month
Cincinnati	$1 per month
Boston	$9 per annum
Buffalo	$12 per annum
Baltimore	$12 per annum

LAST CALL

On November 1st, 1916, the subscription price of "The Electrical Experimenter" advances to $1.50 in U.S. (Canada $1.85, Foreign $2.00.) This is the last chance to subscribe at the old rates ($1.00 in U.S., Canada and Foreign $1.50). No subscription for more than five years at the old rate accepted. THE PUBLISHERS.

ELECTRICAL FOG DISSIPATION TO BE INVESTIGATED.

The Smithsonian Institute announces that it has made an appropriation to further experiments in the dissipation of fog by electricity, and that the investigations will be carried out under the general direction of Dr. F. G. Cottrell, who has already done much toward the practical precipitation of dust, smoke and chemical fumes in large industrial establishments. The idea of dispersing fog by electrical methods has been before the public for a number of years, though it appears never to have reached the stage of feasibility, on a commercial scale. The subject has recently aroused fresh attention, particularly in the neighborhood of San Francisco, through researches planned by the University of California in co-operation with the United States lighthouse service. The American Institute of Electrical Engineers has also appointed a committee to co-operate in this work. According to the Smithsonian report, the essential element to success seems to be some form of electrical apparatus of very high direct current voltage, with facilities for its control and ready application.

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on. No attention given to unsigned communications.

Advice to Correspondents:

Before writing to these columns kindly bear the following in mind:

It is a comparatively easy matter for anyone to procure a patent. Anybody with a little mechanical and electrical ingenuity should find no difficulty in obtaining a patent and thousands of such useless "patents" are taken out every year.

The thoughts which should be uppermost in every inventor's and would-be inventor's mind are the following:

Is the idea practical?

Is there a demand for the device?

Does it fill an actual need?

Would you, yourself, if you had money, invest it in the exploitation of the idea?

Only after you have answered these questions to your full satisfaction should you begin working on the invention. There is no glory in getting a patent, and, as stated above, most anyone can obtain one.

Inventors can save themselves much hardship and much disappointment by bearing the above in mind.

This Department has been flooded with a great many useless ideas on which correspondents desired information and we hope the above statement will be borne in mind when writing to "Patent Advice."

NEW TYPE D. C. GENERATOR.

(93.) Earl W. Becker, Jamaica Plain, Mass., sends us description of a device which he has recently perfected. He would like to know if the device is patentable. He also desires to know if the machine is similar to that which was discussed in these columns in the March issue of The Electrical Experimenter.

We are inclined to think that the machine in question would not give D.C. current. We are almost positive that the current would be A.C. We would advise our correspondent to get our book, "Dynamo Electrical Machines," sent prepaid for $1.50. This treats on the subject very extensively and many similar schemes are shown in this book. The idea in question is not at all similar to the one described by us before.

UNPATENTED INVENTION.

(94.) Geo. Brooks, Brooklyn, N.Y., writes as follows:

Will you kindly give me your opinion in these columns as to whether it is ever advisable to take up an invention with a manufacturer before the patent is allowed—that is, while the application is pending? I have been told that if such is done, in the case of unscrupulous manufacturers, it is always possible for them to force an interference with the hope of discouraging and freezing out the inventor. I would value your opinion on this subject.

You are quite correct in your statement. Cases where an unscrupulous manufacturer takes up an unpatented invention similar to the one you cite, are not at all uncommon. If you have not already obtained a patent, we would advise you to get one. The only other revenue left open would be to interview those manufacturers whom you know from experience to be worthy of your confidence. Quite a few ideas are sold in this manner to manufacturers of standing, and the preliminary agreement can be drawn up with them, which in many cases becomes binding, all, of course, depending on the nature of the invention, but the safest way in all cases is to take out a patent.

TELEPHONE PENCIL HOLDER.

(95) Merret Johnson, San Antonio, Texas, has sent in a sketch showing a pencil holder for a telephone and would like to have our opinion of same; if the idea is original, if a patent could be obtained upon it, etc.

(A) This is a fairly good idea, but without a paper pad we do not think it will amount to very much. In its present form we doubt very much if a patent could be obtained upon it. However, a small article of this kind might prove a successful manufacturing device, as it probably could be made to sell for 25c. or less.

OVERFLOW ALARM.

(96) Arthur Walsh, Montclair, New Jersey, wishes to be advised through the Patent Advice columns as to the practicability of an overflow alarm, sketches of which he has submitted to us. He also submits a sketch and description of an illuminated sign and desires advice on this also.

(A) We can find nothing new or original on these two devices, particularly the former. In this connection we would advise correspondents that there does not seem to exist a good market for overflow devices that attach either to ice box basins or to large water tanks. Nothing novel is shown in the illuminated sign.

SPEED PREVENTER.

(97) Vancil V. Roe, Minneapolis, Minnesota, has submitted an idea by means of which automobiles in large cities could be prevented from speeding—automatically—by installing a device inside of the car, which, as soon as the speed of the car becomes excessive, would cut off the power at once automatically. Our correspondent wishes to know what we think of the idea.

(A) The idea, as far as it goes, is an excellent one. There is, however, a big "But" connected with it. No automobile owner would, of his own accord, buy such a device for obvious reasons. It would necessitate the passing of laws in order to compel him to do so. Some localities would undoubtedly do so, but the inventor of the device would face an almost unsurmountable task to exploit such an invention and it is almost certain that not every city nor every state would pass such a law, upon which the entire practicability of the idea hinges.

SWITCH.

(98) E. F. Durbin, Orange, California, has submitted a design of a special single blade double pole switch which is quite ingenious. He wants to know what we think of it.

(A) While an excellent idea, we think that in practice such a switch would be too troublesome. Also, we do not think it would work quickly enough for general practice. Perhaps, by improving it, this objection might be overcome. The idea otherwise seems feasible.

WITH THE NOVEMBER ISSUE

we will present a new

SUPPLEMENT

of a famous electrical inventor. This is the first of a series promised to our readers.

These supplements are printed on fine art paper, ready for framing. They are invaluable to adorn your den, your wireless station, or your laboratory.

Order your copy now, to make sure you will get it.

TELEVISION.

(99) Russell Quatermas, Marshfield, Oregon, would like to know if the device which he submits to us on television will work and whether a patent could be obtained upon it. He has imagined a screen, made up of many small particles of selenium with wires attached to each particle. This is the underlying idea.

(A) This scheme will not work. Simply by attaching wires to selenium particles will not cause them to be active selenium cells. Also, too many wires would have to be used, which makes the device at once impractical.

Ruhmer of Berlin had patented a device whereby he used a great many selenium cells which made up a large square. Geometric figures were thus transmitted at a distance. But in order to make a practical device of this kind for television, i.e., to see a person over a wire, the person to be moving at the same time, so many selenium cells would have to be used that the apparatus would cost above $1,000,000 to construct; and for that reason devices of this kind, employing selenium or selenium cells, have, so far, been unsuccessful.

The world's largest electro-magnet is being built in Paris at a cost of $40,000. The magnet will be used for experimental work.

THE ELECTRICAL VILLA OF A THOUSAND WONDERS.

(Continued from page 390)

was the genii who essayed the role of major-domo. Upon the large electric range there were a number of aluminum cooking utensils electrically heated. Miniature electric lamps were placed inside of the utensils, so that a piece of meat, for instance, could be inspected while being cooked. Extremely clever schemes had been worked out by M. Knap for performing a number of the usual culinary operations. One of the most interesting of these was a chicken broiler, which does not employ direct thermal heat but the reflected heat energy from a number of specially constructed powerful incandescent lamps. These lamps are suitably mounted in aluminum reflectors, while the heat rays are concentrated upon the chicken. And, moreover, when the fowl is properly broiled to the most toothsome point a bell rings and the Chef is notified that it is ready to serve. When it comes to boiling eggs, this is most quickly and expeditiously done by an automatic timing arrangement which will boil them for any given number of minutes. Mayonnaise sauce is made in a jiffy by an automatic, motor driven, stirring device which opens its own electrical circuit after a period of three minutes.

At one end of the Chef's domain there is a circular table containing a number of cooking apparatus so that one may sit in a chair at one point and simply revolve the table until the desired machine is before him, thus realizing a distinct saving in walking back and forth. This table contains, among other devices, an electrically operated meat hasher, butter churner, paste or dough mixer, and last, but not least, a small polishing and grinding machine for the cleaning of cutlery.

Each one of these apparatus is controlled by a separate switch mounted on the machine. After the meal has been served and the Chef and his assistants are deluged by a host of soiled dishes and cutlery, it becomes an easy matter to dispose of them as it is only necessary to put the dishes in an electrical dishwasher which, at the snap of a switch, is capable of thoroughly cleansing fifty china dinner plates in thirty seconds. Drying the dishes by hand is not necessary as they are sprayed with steaming hot water before leaving the dishwasher, and by the time they reach the outer air they are dry, due to the rapid evaporation of the moisture on them accelerated by dry, hot air blasts.

Before leaving the Chef's quarters the manner of sending up the various dishes, etc., to the table and dining-room above was demonstrated. A lever marked "Up" was simply pressed to quickly dispatch the dish ceilingward to the dining table, and in like manner a lever labeled "Down" brought the dishes down to the serving table in the kitchen.

We proceeded to visit other parts of the mansion and I was shown how music could be heard in every room by means of a loud-speaking telephone neatly ensconced in the walls, and also how conversation in any room could be transmitted by means of Dictaphones hidden in the walls and heard by the host in his bed chamber. Thus, apparently, it would be extremely difficult for the servants to hatch any conspiracy overnight.

In the front hall we saw the controlling switches for the motor operated gate at the entrance to the grounds and also a loud-speaking telephone through which the voice spoke to me as I stood at the portals. Also thermostats were observed on the ceilings in various parts of the house, which I was told, operated fire alarm bells to awaken the guests in event of a conflagration. M. Knap then showed me a Voice-Scriber and let me talk into it, whereupon the machine

wrote off the spoken words. This he explained was in the experimental stage as yet.

I had been so engrossed in the marvels of this wonderful mansion that I was much surprised when I observed that night was drawing near. Monsieur Knap courteously requested me to spend that evening with him, and I was more than pleased to avail myself of such an opportunity.

We adjourned to the reception room and my host suggested a game of billiards to speed the evening hours along. But as in my tour through the house I had observed not a trace of a billiard table, I was certainly at a loss as to how we would be able to play. But no sooner had this thought flashed through my mind than my host, as if to anticipate me, pressed a button and a regular life-size billiard table rose from the floor. An innocent looking panel had covered the table previously.

When the hour for retiring approached mine host bade me *bon soir* and wished me pleasant dreams. I found my sleeping chamber a marvel of convenience and in planning this apartment it was made evident to me that no necessary convenience had been overlooked. I found that by turning a button on a switchboard conveniently located beside the bed, the window curtains could be closed and opened. And, wonder of wonders, an instantaneous electric water heater presented itself for my convenience. As is well known, hot water spigot service is an unknown quantity in most French houses and a bathroom is a rare luxury indeed. Before retiring I discovered that the windows could be closed or opened at my desire by simply turning a switch which controlled an electric motor. Also there were electrically heated hot water bottles for those having cold feet.

I arose in the morning with the sun streaming through the windows and recalling that I had but to push a button to draw the curtains together, I at once availed myself of this service. A telephone placed conveniently beside the bed enabled me to communicate with the Chef and order some breakfast. In a few moments my *déjeuner* had arrived on an automatic electric elevator beside the bed, similar to the one in the main dining-room. After this refreshing meal I proceeded to dress and found M. Knap in the reception room busily engaged in reading the morning papers.

Before bidding him farewell, however, he asked me to step into his electrical conservatory, where he grew several of the choicest fruits in a very short period of time, and all because he simply bathed them in an electric light during the night, so that they proceeded to grow all the time.

And as I bid him adieu he pinned to my coat lapel a boutonniere of electrically grown carnations.

WHEN THE ENGINEERS GO TO WAR.

(*Continued from page 391*)

Besides the excellent training given at West Point, and also at Annapolis, the U.S. Government conducts an *engineers' school* at Washington Barracks, Washington, D.C. This school is under the control of the chief of engineers. Its object is to prepare junior officers of engineers for active duties of their corps, to make experiments and recommendations and to give instructions pertaining to civil engineering work of the Army course of instructions, covering a period of 13 months, beginning September 1st and ending September 30th of the following year. Diplomas are given to students who successfully complete the course.

In time of war the engineering squad collectively and individually forms one of the most important units of the regular army for all sorts of defenses, from that of mining a river or harbor to the construction of a massive concrete redoubt or fortification. Contrary to general opinion it is not always the luck of these highly trained men to be back beyond the firing line, and some of the work includes such hazardous propositions as the rebuilding of bridges or complete Pontoon bridges under fire, as witnessed in many of the pictures which have arrived from the German army battle lines in the present war. Also the destruction of buildings and bridges raked by rifle or artillery fire and the construction of telephone and telegraph lines, which are often under gun fire, besides many other details of military work, such as surveying various building operations, trenches, big gun mountings and railroad track layouts.

The illustrations shown herewith bring out some of the unusual points of military engineering. The first view shows two German engineers placing a mine under a concrete bridge, under the direction of a superior officer. Possibly within a few moments' time this bridge will be no more. The engineers will leave the bridge and at the touch of an electric button this mighty structure of stone and cement will rise like a thing alive for a moment—then collapse into a shapeless heap of ruins. Some of the bridges dynamited by the demolition squad in order to check the advance of the enemy have been half a mile or more in length. Several of the finest bridges in Europe have been thus destroyed, for tactical purposes.

The electrical features, which, of course, include the radio telegraph in modern military manoeuvres, either in time of peace or war, are quite colossal by themselves. Wonderfully powerful electric searchlights sweep over the sky at night in search of the enemy's aeroplanes or Zeppelins, while on the other hand several thousand volts of deadly current may be passing through the barbed wire fences, separating the fighting factions. The soldier on touching such a fence is often electrocuted. Electricity plays a very important rôle in the ignition of the explosives, particularly those used for mining or dynamiting any structure which must be blown up. A small electric battery or dynamo furnishes the current for these operations, and at the touch of the button the electric current passes with the speed of lightning over the fine copper wires, which terminate in a cap or igniter, which fires the dynamite or high explosive charge.

When the army retreats it is often found by the advancing enemy that his foe has prepared a very warm reception for him in the shape of a thoroughly mined and electrically wired field. In some cases these mines are connected up with electric wires placed 1,000 feet or more away, so that the retiring troops can wait until their adversary has advanced on to this area, when, at the push of a button, the ground, troops, cannons and everything are hurled skyward.

The various units of a large army are kept in constant touch with the general in command and all officers of the general staff by telephone, telegraph and wireless. The signal corps take care of most of the signaling installations, such as those just mentioned and the portable wireless outfits now used by the army and navy can be unpacked and set up ready for instant use in a few minutes' time after their arrival upon the spot.

The engineer, or those who have a hankering for the military phases of engineering, will find that a vast amount of interesting work awaits them. There is always a plentiful number of new problems awaiting solution, particularly those covering electrical branches of the art, aside from those of gunnery, range finding, sanitation, transportation, and the building of fortifications.

A TRIP THRU A MODERN RESEARCH LABORATORY.

(*Continued from page 394*)

head of the department as to the manner in which the tests are to be conducted. Each transmitter is connected with its respective receiver in a different room, which is also under one man's control. The operator in the transmitter room continuously speaks in a uniform tone to his group of instruments, thus performing the same duty as if they were in actual service. A large number of operators are employed exclusively for testing these instruments; by these tests the operating characteristics of the different parts of the transmitters are determined. The work is conducted by a number of transmission engineers; several phonographs are also used as sound generators. The transmitter under test is placed over the reproducing head of the machine and the head is automatically released when it reaches the end of the record, and brought back to the beginning. This operation is performed continuously. The instrument is enclosed in a sound proof cabinet so that the sounds produced will not interfere with the operators around the machines.

The selective party line ringing testing laboratory was next visited. In this room every conceivable ringing device is put under a severe test. A part of this laboratory is illustrated in Fig. 2. The numerous wires on the wall are connected to various ringing instruments, stationed about the room and currents of various frequencies are supplied by generators located in the dynamo room. The oscillograph on the table in the background is used for determining the operating characteristics of the instrument when tested with currents of different frequencies. The bank of bells above the oscillograph are under test. The switchboard on the right is used for controlling the different forms of currents supplied to this laboratory.

We passed on to the incandescent lamp room, where the miniature electric lamps, used on telephone switchboards, are tested. The lamp panel is shown in Fig. 3. The various jack plugs on the switchboard are used to supply current of any voltage to any one of the racks, each of which contains a large number of spring contacts, in which the lamps are held, and also serve the purpose of connecting the filament to the current supply. Every one of these lamps is put under a life test so as to determine the number of hours each lamp will last under normal operating conditions and each rack is operated with a different voltage. The ammeter on top of the switchboard indicates the number of amperes that the rack consumes. The two metallic covers above the racks are used for conveying away the heat developed by the large number of lamps under test.

Various instruments developed by the company are put under a wearing-life test. The laboratory which cares for this work is seen at Fig. 4. The machines in the foreground are testing a number of switches under accurate service conditions. Each cam operates one switch. The machine on the center of the table controls a number of side operating lever switches. Each testing machine is fitted with a counting instrument, so that the number of times that the switch is operated and released is accurately known.

Incredible though it may sound, thousands and thousands of dollars have been expended on the development and perfecting of the little green flexible cord used on the telephone receiver. This cord is made up entirely of fine metal strands of tinsel wound around a cotton thread, then twisted into a bundle to serve as a conductor for the electric current. Every time the tele-

phone receiver is removed from the hook the cord is bent, and each bending brings nearer the time when one or more of the tinsel filaments will break. As these filaments break, a fine cracking sound is produced in the receiver, which interrupts the clearness of the conversation that is going on over the wire, an annoyance to the user of the telephone which forces him to discontinue the use of the apparatus, which necessarily means a loss to the operating company. This was a great nuisance in the olden times due to the imperfect tinsel conductors used. Therefore development work has been carried on in the laboratories in order to perfect the qualities of the fine metal tinsels used in that little green cord as well as the cords used for switch board work. Life tests are also conducted on these flexible conductors.

Did you ever notice the finish on the metal stand of your desk telephone? Well, that particular detail has worried some of the best telephone engineers. Considerable time and money was spent a few years ago to build a special set of apparatus, with which it was proposed to bake on an especially tough, wear-resisting coating on desk stands. Some persons' perspiration would attack certain finishes and so it came to pass that this one finish, which was in the process of development, never lived to meet the telephone-using public. Many other similar examples could be cited which would total up a king's ransom, and no small one at that.

This description gives the telephone user something to think of when he puts five cents in the slot of a pay station. How many nickels must be spent, even daily, to support these laboratories with their expensive equipment and highly paid employees?

THE FEMININE WIRELESS AMATEUR.

(Continued from page 397)

tion of new posts will be carried on rapidly, as many applications for membership in such posts in various cities have been received. The girls' division of the Naval Reserve has been formed not for a handful of girls whose parents can easily afford to pay for a few weeks' training in a camp, but to reach out to girls who need the training and discipline which the reserve assures them but are unable to pay for such training. Funds to help them in the work prescribed are needed.

There are many girls who are desirous of such training to make them better citizens, who are inspired with patriotism that is just as keen and unselfish as the patriotism that sends the young men and youths of the land into the militia, the regular Army or the Navy. With the training which the Naval Reserve will give them these girls will be fitted for hospital attendants, Red Cross nurses, operators of wireless telegraphy and many other positions in case of need.

The training of the girls who volunteer for work will not be altogether with a view to service to their country in the time of war, but in the time of peace as well.

The science of wireless telegraphy is one of the newest and at the same time one of the deepest subjects extant. The practical ideas have been worked out, it is true, so that an operator can simply close a switch and proceed to manipulate the key, but there are a thousand and one problems of every variety imaginable to be investigated and solved before radio will become anything like an *exact* science.

Primarily speaking, radio operating requires more than a knowledge of how to "punch" a telegraph key, differing greatly in this respect from wire telegraphy. The schools teaching radio have worked out the problem of imparting the necessary training in a very reasonable time, however, varying from a few months up to a year. The training period depends, of course, upon the knowledge possessed by the student when he or she enters the school.

Basically, of course, the predominant idea is to thoroughly inculcate upon the student's mind the method of handling the transmitting key, which resembles a regular Morse telegraph key exactly. The signals are heard in the telephone receivers, strapped to the head, in the form of short and long buzzing noises. There is no *back kick* sound as in wire telegraphy, which arises from the *sounder* arm falling back against its stop.

Besides the usual message form lessons, radiogram make-up, abbreviations, etc., there are the highly interesting and necessary studies of how the waves travel through the ether; electromagnetic induction, dynamos and motors; storage batteries; tuning of the apparatus to different wave lengths so as to eliminate interference from other stations; procedure in case the dynamo current fails; et cetera. It takes a good head for all these studies and so it becomes self-evident that it is a very honorable accomplishment to have graduated as a first-class radio operator.

Again, this is not the end and all of the proposition at all. We have before us the great and as yet, but little explored field of *radio engineering*. Women seem to progress excellently in the engineering branches. Primarily this is so because her brain is quick of action, and moreover she usually will be found to have extremely well-balanced ideas as to proportions, so essential in designing. A wonderful imagination coupled to a number of other worthy faculties help to make a really fine combination, so that we find a steadily growing number of women architects, mechanical and electrical experts, radio operators, civil engineers, *ad lib.* What we need is more of them in the higher positions, where the square root and binomial theorem are everyday quantities.

HOW THE FARMER USES ELECTRICITY.

(Continued from page 399)

tural electric supply schemes. In the United States, California used more power per head of population than any other American state. Canada, Australia, New Zealand, Italy, Austria, Switzerland, Denmark and Holland also have important examples of electrical installation system and service for agriculture. Mr. Kerr based his advice and the conclusions which he put before the convention of the municipal Electrical Association upon some years' experience in farm supply work in his own neighborhood, Hereford. He holds that there is an enormous business of a similar kind awaiting development in England. In Hereford district a system of light transmission lines has been erected to reach agricultural consumers.

To prevent cattle from rubbing against the poles they are placed close into the hedges.

In an average case, stated this engineer, a 10-horsepower motor will meet all the requirements of a farm except for threshing and cider milling, but motors up to 20 horsepower have been hired out for these purposes, which are only seasonable jobs and do not require a permanent fixing.

He gave descriptive information concerning a dairy installation which included a vacuum pump for the milking machinery. This machine requires 1.5 horsepower and is used twice daily for two hours in the morning and 1.25 hours in the afternoon. The cows milked average about 70, and the machinery capacity is for 88. The

farm bailiff states that it would require five men at least, who are expert milkers, to do the work in the same time, or with his present staff five or six hours a day longer. In regard to root-pulping and chaff-cutting, experience shows that owing to the easy starting of an electric motor the exact quantity of food can be cut and mixed fresh as required, a very important result being a greater yield of cream in the milk.

There were as a rule five farms to the mile along an average road, and many ordinary country residences. An average revenue of at least $500 per annum would be yielded from the five farms and between $100 and $1,000 from the private houses, as there were large country residences which were only too anxious to have such a permanent source of supply, paying twelve cents per unit for it. Mr. Kerr said that existing data showed that the average consumption of current in an agricultural district with a population of 22,500 was 58 kilowatt-hours per head, and for the population of the county of Hereford (114,296) he estimated a possible sale of 6,637,000 units; that is in an area of 40 miles long by 35 miles wide, with a central distributing point.

The tiller of the soil is becoming more of a scientist every day, with electrical schemes for performing not only his ordinary "chores," but such philosophical desideratums as "ridding the earth of insects and their larvae electrically" as described in the August, 1916, number of THE ELECTRICAL EXPERIMENTER, on up to the subject of "Electric Horticulture." Papers on the latter and many other vital subjects can be procured from the Superintendent of Documents, Washington, D.C., also from the Department of Agriculture, Washington, D.C.

ELECTRICAL FRAUDS.

(Continued from page 392)

the American backwoods or in darkest Russia. It was advertised in full page advertisements in the largest and most respectable German weeklies for several years, right up to the outbreak of the present war. Wonderful photographs showed "before using it and after" effects The pictures were most impressive, as well as wonderful, and many "physicians" lent their names to praising the marvelous power of the "grower."

An inspection revealed the fact that the handle contained a single dry cell giving one and a half volts and about two amperes *while new*. This constituted the full electric equipment. The current went through the handle into your hand and from there through the body and through the head into the metallic ball-pointed bristles, thence back to the battery. When the scalp was wet there is no doubt that a very anaemic current dragged itself through the hair roots of the scalp, but we refuse to believe that a one and a half volt current flowing through the high resistance of the human body can sufficiently stimulate dead or weakened hair-papillae to make even a passing impression. A fraud pure and simple and as clever as it is simple. Some of these elaborate outfits with "attachments" and all sorts of refinements sold as high as twenty-five dollars for the set. And that in enlightened Germany!

Preposterous as the above device is, the magnetic hair brush and the magnetic hair comb, illustrated in figures 6 and 7, go it one better. Of course they are, or rather *were*, made in America, till Uncle Sam, through his Postoffice Department, closed up the thriving manufacturer for defrauding the public through the mails. Hundreds of thousands of these appliances were sold at one time, and it is safe to say that thousands of them are still in use this minute.

The "electric" brushes sold from $1 to $3 and were good hair brushes as brushes go, but that was all. There was no pretense made of a battery being supplied, though the name would lead you to believe so. Under the cover there was a mediocre permanent steel magnet. That was all! And to prove to you how "strong" this brush was, the makers supplied a little compass with it! Bringing the brush near the compass, the needle would be agitated of course and the layman thought this was a sure test of the marvelous inherent curative power of the brush.

Powerful electro-magnets, capable of lifting tons, have been used in experimenting upon humans and animals and a famous French institution, after several years of study, has announced that magnetism, no matter how strong or how weak, has not the slightest effect whatsoever upon the human body, its nerves or the senses.

Notwithstanding this the "electric" hair brush makers in their literature claim the following for their brush:

They will positively CURE nervous headache in five minutes; bilious headache in five minutes; neuralgia in five minutes; falling hair and baldness; dandruff and diseases of the scalp! Promptly arrest premature grayness. Make the hair grow long and glossy. Immediately soothe weary brain. They have won their way to royal favor in England, being cordially endorsed by the Prince and Princess of Wales, used by the King of Holland and Prince Bismarck, and written upon by the Rt. Hon. W. E. Gladstone. They cure by natural means; will always do good, never harm, and are a remedy lasting for many years. They should be used daily in place of the ordinary hair brush, hair washes or hair growers.

And let no one think that the bristles were of steel or iron to "conduct" the magnetism to the hair-roots. Indeed not, ordinary bristles were used!

The "electric" comb as shown in figure 7 belongs to the same class as the brush just described. A permanent magnet was vulcanized into its back. That was all. Its curative power was claimed to be almost as high as that of the brush!

Then there was the "electric" tooth brush, figure 7, having a metallic handle with the bristles set into the metal. This clever device sold readily and as with "electric" belts it really does produce a weak current for a few seconds. Here the current enters the hand by the handle, from where it flows through the body and moist tongue as well as moist lips, back to the brush. The electricity in this case was claimed to produce "sound, white teeth and rosy gums"!

Figure 7 also portrays the magnetic finger ring as well as the "electric" finger ring. Of these hundreds of thousands have been sold and are still being sold in this country. The price of the rings varies from twenty-five cents to one dollar apiece! The magnetic ring is a plain steel band shaped like an ordinary ring; it is of course magnetized. When worn steady it cures anything from acute rheumatism down to snake bites!

While the magnetic ring at least owns a bit of real magnetism, its brother, the "electric" ring, is as dead as a doornail, even when "worn steadily." It is a thick band of copper, while in its inside a second ring of zinc is let in; see figure 7. The zinc is flush with the copper, as will be observed. No pretense is made to insulate the copper from the zinc, consequently the two metals are thoroughly short circuited in an efficient manner. Such a contrivance can of course not even produce a momentary current as does the "electric" belt, while the perspiration of the finger naturally short circuits the two metals still further, if that were possible. The action therefore is nil, as far as electricity is concerned.

The magnetic razor, figure 8, is another offender and though very few makers advertise great claims for its "power," still a host of laymen are misled, as they think that such a razor has certain wonderful properties. Healing or curing powers are now seldom claimed by the makers, but the salesman selling it over the counter, not infrequently uses very fancy "scientific" selling talk. Their claims run from "smoother shaving," "keener edge" down to "prevention of barber's itch," etc., claims which were never dreamed of by the makers.

We have already stated that magnetism has absolutely no effect on the human body, either positive or negative and a magnetic razor certainly does not change this fact. As a matter of fact, the writer, for one, rather shaves with a non-magnetic razor. This is the reason: Some years ago we had occasion to view a non-magnetized as well as a magnetized razor under a powerful microscope. The former showed a clean ragged edge with clean "teeth," as does any good razor. The magnetic razor, on the other hand, had minute steel particles clinging to the teeth, held there by magnetism. Continuous stropping did not improve the condition; some particles no doubt stuck to the stropper, but new ones, torn off from the razor's edge took their places. It was the writer's belief that such fine steel particles might find their way into an open cut and while this might not be very dangerous, there is no necessity for inviting unnecessary trouble.

One of the most curious "electric" frauds that ever came to our attention was sent to the writer by a Texas prospector some years ago. This "ore finder," figure 9, was marketed by a Pennsylvania concern and the contrivance sold for fifty dollars. Its manufacturing cost is perhaps four dollars.

The apparatus is nothing but an ordinary nickel-plated buzzer mounted on a nickel-plated tube, which contains a common tubular flash light battery. An adjusting screw is mounted on a bracket which is supported at the bottom by a spring. It is evident that if any pressure is exerted on the spring at the bottom, contact will be made and the buzzer will operate. Just how this contact is brought about we are as yet ignorant, but we presume that the "Mineral Magnet" performs this function!!

This "mineral magnet" is supposed to start in jerking the string as soon as it comes near a lost treasure, presumably out of sheer excitement. It will also act in the same manner for other minerals.

This is what the makers say about it: "The reason our instruments are the best and most sensitive is that the *mineral magnets* are composed of the latest discovered and deepest earth penetrating magnetic composition known to electricians and mineralogy science. We guarantee our instruments to be the best and most perfect instruments ever invented for prospectors seeking mines and hidden treasures. All our mineral magnets are made on a scientific basis, they are hollow, filled, charged and sealed with each affinity, (? !!) Electro Magnet mineral which produces the proper attraction for locating any of the above named minerals.

"To make location without instruments the prospector takes hold of the electric light battery magazine with both hands as described in illustration, holding it directly in front of him and as level as possible, following in the direction in which the mineral magnet leads, and as soon as the deposit is reached the magnet will have a downward attraction, which will cause the electric buzzer to make a continuous noise, incidentally showing the exact location.

"We guarantee our instruments to detect about two thousand yards, and to the depth of from five to eight feet according to the

condition of the soil and the richness of the deposit."

The concern furthermore states that the price of the "ore finder" is $50.00 cash, but in the same breath it goes on and says that it will let any prospector have the meter for $15.00 with the understanding that he will pay $50.00 every time he makes a successful paying location!!

That any one person in his right senses should buy such a contrivance is beyond our understanding. It does not seem to enter these poor prospectors' heads that if the thing really worked the man who made it would go prospecting himself.

However, as long as the people want to be fooled and are willing to pay for it, we presume we have no right to complain.

MARVELS OF MODERN PHYSICS.

(*Continued from page 407*)

Low temperature phenomena have a very direct bearing on the theory of electrical conductivity, magnetism, specific heats, and in general, the whole theory of the constitution of matter. In nearly all metals, the electrical resistance decreases with the temperature, and Onnes found that *near the absolute zero the resistance practically vanished altogether*. The behavior of mercury for instance is remarkable, and is shown in the graph Fig. 1. The resistance is plotted as a ratio, that is, its value at any temperature is divided by its value at 0 deg. Cent., but this does not affect the quality of the curve. The resistance of the mercury decreases regularly until at about 4 degrees above absolute zero it suddenly falls to about a millionth of its original value, or approximately zero. At this point it becomes almost a perfect conductor. Tin and lead show the same effect, and Onnes using a coil of lead wire immersed in liquefied helium, introduced a current of electricity into the coil and short-circuited it. Due to the boosting effect of inductance and the negligible resistance he found the current had not decreased noticeably after two hours. At such a point, the voltage might be an extremely small fraction and still the current would be thousands of amperes. Think what this might mean in practical work, if the resistance of a power circuit could be reduced to a millionth of its usual value! The power available would then be as great as from a million such circuits.

Under the electron theory, the dying out of the kinetic energy of the molecule and its inter-atomic forces and movements, seems to remove any resistance to the motion of the electrons in a current.

Curie derived the law that the paramagnetic susceptibility of a substance is inversely proportional to the absolute temperature, but it had been found that near absolute zero the law does not hold good. It has also been ascertained that specific heats change irregularly at low temperatures, and a careful study of these facts and the facts of conduction show a continual relationship, and one which points to a simple connection between them all. The absolute zero is no doubt an unattainable limit, and also a barrier behind which are hidden many of the secrets of physical phenomena.

No mention has been made so far of the different temperature scales, and the method of measuring very low temperatures. The Centigrade is the scientific scale in common use, while quite often the *absolute* scale is used. A comparison of these and of the common Fahrenheit scale will be found in Fig. 2. The zero of the Fahrenheit scale was taken at 32 degrees below freezing, at what was then thought to be the lowest possible temperature. The Centigrade scale aimed at a more rational size of unit, and Celsius, its inventor, took freezing water as zero, boiling water as one hundred, and divided the intervening space into one hundred degrees of equal size. The *absolute* scale as seen begins at absolute zero, using the unit of Celsius, and measures all temperatures in positive terms or in degrees above zero. The absolute temperature can be obtained easily by algebraically adding the Centigrade reading to 273.

The fact that both mercury and alcohol freeze at medium low temperatures makes it impossible for them to be used in extremely low measurements. In their stead a gas thermometer is always used, assuming that the gas in the thermometer follows the law of a perfect gas. It is thought that any possible error is exceedingly small. The typical kind is shown in Fig. 3. The bulb B is first filled with a gas, usually hydrogen; then mercury is introduced into the tube leaving a vacuum above the column at V. Cooling or heating the bulb B will cause the gas to expand or contract and force the mercury down at H or draw it up, but the level of the mercury can always be returned to H, thereby keeping the volume of the gas constant by simply raising or lowering the other arm of the tube V. As is well known, the pressure of a gas varies directly as the absolute temperature of the volume is kept constant; therefore the pressure necessary to keep the volume constant is a measure of the temperature. It is easily seen that the pressure at H depends on the height of the mercury column in V above H, hence we find the scale on H measures this height in terms of degrees.

If the level in V and H were the same, that is if no pressure was being exerted, the pressure of the gas would also be zero, and as we already know the temperature would also be zero; but as the mercury in V can sink no lower than in H, that is the point of lowest possible temperature.

All study of heat brings us finally to the questions of its origin and meaning. Lord Kelvin says that our great source of heat—the Sun—will not continue to radiate enough heat to support life on the earth for more than a few million years at most. If so, what will happen then? The fact that heat and electricity in their radiant forms are one and the same, shows how fundamental each is and how closely related. The field of Heat is not a narrow one, but only another gateway to the entire field of Physics.

WHEN "COLUMBUS" USED THE TELEPHONE.

Teacher—I'm surprised at you, Sammy Wicks, that you cannot tell me when Christopher Columbus discovered America. What does the chapter heading of the week's lesson read?

Sammy—Columbus, 1492.

Teacher—Well, isn't that plain enough? Did you never see it before?

Sammy—Yes'm, yes'm, but I always thought that was his telephone number.

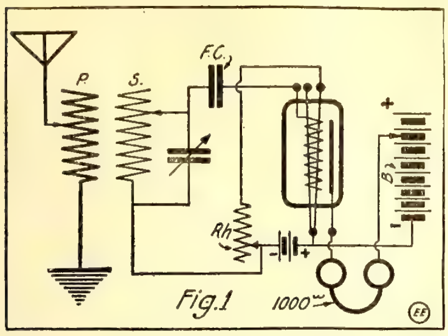
RADIO LEAGUE OF AMERICA.

(*Continued from page 409*)

small one with a loaded primary and secondary.

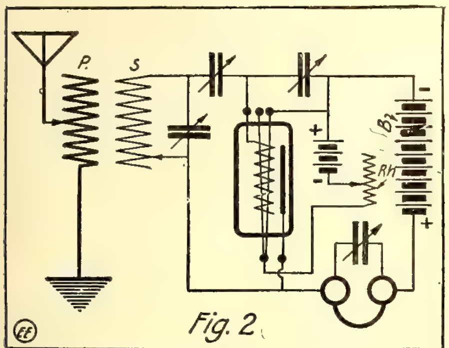
Our aerial is 170 ft. long and 100 ft. high. The ground wire is 125,000 cir. mils, terminating in a buried ground rod in the bottom of a wet manhole outside the office and also strapped to underground gas and water pipes. We did not always have such good aerials and grounds say Messrs. Mühlheizler and Weaver. Several years ago we started out using brass beds, bed springs, and umbrellas for experimental aerials. Then, after a while, we got real aerials. A newspaper man hears about it; one day he ran out of news and printed in big type—"Weaver & Mühlheizler, Laziest

Wireless Operators in the World—Send in Bed—and by staying in bed Sunday morning converse over a distance of four miles and indulge in antipathy"—whatever that



Tubular Audion Hooked Up to Receive Damped Wave (Spark) Signals.

means; the dictionary says it means repugnance—so there you are again. At any rate we are always on the job.



Connection for Tubular Audion to Receive Undamped Waves.

(*Addition to list published in July issue.*)

REVISED LIST OF AMATEUR RADIO CLUBS.

Central Radio Club, Topeka, Kan. Secretary, Wm. A. Beasley, 1517 Western Avenue, Topeka, Kan.

Hillsboro Radio Association, Tampa, Fla. Secretary, V. C. McIlvaine, 208 Verne Street, Tampa, Fla.

Jersey City Y.M.C.A. Radio Club, Jersey City, N.J. Secretary, Harry Reich, 315 Germania Avenue, Jersey City, N.J.

Monroe Radio Association, Monroe City, Mo. Secretary, Harry E. Longmire, Monroe City, Mo.

Roslindale Wireless Association, Boston, Mass. Secretary, Frederick Frueh, 962 South Street, Roslindale, Mass.

South Philadelphia Radio Club, Philadelphia, Pa. Secretary, Joseph Cutley, 1217 Wilder Street, Philadelphia, Pa.

The Grape Belt Radio Association, Silver Creek, N.Y. Secretary, R. H. Lilley, Eden, N.Y.

The Prospect Radio Club, Brooklyn, N.Y. Secretary, Lloyd Jacquet, 478a Sixteenth Street, Brooklyn, N.Y.

Watertown Wireless Association, Watertown, S.D. Secretary, George Wilson, 228 First, S.W., Watertown, S.D.

Name of Club..............................
Founded ....
No. of Members............................
Meeting Date ....
Power of Club Set, if any.................
Call Letter (licensed?)...................
Dues and Initiation Fee...................
Secretary's Name and Address..............

SOME INTERESTING NEW RADIO APPARATUS.

(*Continued from page 410*)

in the background. A fixed condenser is shunted across the terminals in order to prevent sparking and thus save the platinum tips. Not only can this instrument be used as a buzzer test but it can be used as a buzzer transmitter. Different frequencies can be obtained with the instruments providing a different tuning fork is used. If several of them are employed and each emits a different tone, an electric "piano" can thus be made. It is suitable for testing purposes and as an exciter for wave meters.

A very clever radio transmitting key has been recently put on the market which is shown in Fig. 5. The lever is held between two rectangular brass blocks by a pin, with contacts placed on the side of the arm as indicated. These are made with flanges so as to permit the sparking surface of the contacts to be cooled. It has been found that a greater amount of current can be handled with this key than with the ordinary radio type as used heretofore. The reason for this is that larger contacts can be put on this key than the other standards; the explanation is self-evident from the illustration of the key.

A variable condenser which gives a linear or straight line calibration curve is illustrated at Fig. 6. The rotary plates are so constructed that practically zero capacity is obtained; this is done by rounding the edges of each of the plates, as can be seen. They are specially mounted so as to obtain perfect balance throughout the complete rotation of 360 degrees. A rotary dial is provided on the movable plates, and a stationary indicator secured to the cover. This condenser is very suitable for all kinds of measurement work and especially for a wave meter capacity.

An audibility meter which measures the intensity of signals heard on the receiving instruments is shown in Fig. 7. This, like other audibility instruments, operates on the comparison method; that is, a resistance is shunted across the phones, so that the incoming wave is reduced until it is barely heard in the receiver. When this is obtained the audibility of the signal is found by noting the amount of resistance added to the line in order to overbalance the incoming signal. Thus a greater amount of resistance will be necessary to reduce a strong signal than a weak one. This meter is already calibrated and the audibility factors are marked on each of the contacts. Connecting it up with the receiving instruments and rotating the switch lever until the sound in the telephone receivers just vanishes and noting the indication of the contact upon which the lever rests, gives the audibility of the incoming signals. This instrument is extremely valuable in determining the effect of different weather conditions upon radio communication.

The description of the above instruments will undoubtedly prove beneficial to the great army of radio experimenters who are constantly looking for something new in designs for radio instruments.

REMARKABLE TRIP BY ELECTRIC AUTO.

A trip by electric atuomobile from Boston to Portland, Me., and return was made recently by Mr. Rogers of the Anderson Electric Car Company and Mr. Kelley, manager of the New England branch of the Philadelphia Storage Battery Company. The run to Portland was made in 7.25 hours, and the return trip in 7 hours, the distance being 129 miles, owing to a detour of several miles. The car was a Detroit electric, taken from stock, and was equipped with Philadelphia thinplate storage batteries.

ELECTRICITY NOW PARES ALLIES' VEGETABLES.

The tons and tons of vegetables required for canned stew to feed the fighting forces of the allies now in the trenches *Somewhere in France* will not be touched by a human hand. They will be pared electrically.

A Canadian company which has recently received a contract for millions of cans of a desiccated compote, or stew, composed of six vegetables, for consumption by the allied armies has purchased a large number of electrically-operated vegetable-paring machines manufactured in this country.

The American blue jacket will also be fed with sanitary pared vegetables, a contract for a number of these machines for use in the American navy having recently been made by the United States government.

Nearly 3,000,000 dollars' worth of electrical apparatus was exported in February, 1916.

RADIO TELEPHONY ON THE MEXICAN FRONT.

(*Continued from page 411*)

ployed with this outfit is of the Audion type as the reader will observe on the side of the receiving cabinet. The bulb is protected from outside blows by a semi-circular wire guard. This permits the set to be carried about without danger of injuring the detector. The current for the filament is obtained from storage cells. These are seen standing on the ground.

The aerial mast, of steel tubing, stands behind the outfit, and it takes but a few minutes to erect it, ready for work. The output of this particular outfit is 1 k.w., sufficient to transmit 100 to 150 miles, which is high indeed considering the climatic and topographical conditions found in Mexico.

SAXONY CONTROLS ALL ELECTRICITY.

The government of Saxony has decided to take over complete control of the generation and distribution of electricity in the state. Coal fields and one big generating station already have been acquired and the Saxon Landtag has just voted several million dollars for further outlays. Eventually it is expected that the whole electrical supply in the kingdom will be taken from the state system so that the government will be able to fix the lowest possible charges. At the same time the government has no intention of preventing local public bodies or private corporations and individuals from producing their own electrical power.

As a beginning, the government has purchased for a million and a quarter dollars, the steam generating station at Hirschfelde on the river Neisse, belonging to a Berlin company. This station has already a capacity of 25,500 kilowatts and the plant is quite new. Moreover it is close to one of the coal fields bought by the state. Later the government will erect new works near the western coal fields, where there are already stations with which negotiations are now going on to arrange the necessary cöoperation.

A new department of the government to be called the "Direction of the State Electricity Works" will be established to manage the scheme.

AN IMPROVED AMPLIFIER FOR RADIO AND PHONOGRAPHS.

(*Continued from page 412*)

ture construction and is secured to the journal arm of the reproducing head as indicated. This microphone is composed of a tiny diaphragm placed in a metallic frame, but insulated from it, while fine granules of carbon are placed in a cup which is secured to the frame. Connections are made from the diaphragm and carbon grain cup. The instrument to the right is one of the loud speaking telephones. Of course several of them can be connected in parallel and controlled by switches, as indicated in front of the phonograph. In paralleling the telephones great care is taken to equalize the resistance of each microphone so as to obtain the maximum results. The device to the left is an acoustic resonator and is used for tuning the diaphragm of the receiver with that of the horn used so that both may be in resonance.

This phonographic arrangement can be put to many uses; for instance, music can be sent to numerous places such as cafés, hotels, dance halls and gardens. A similar scheme has been in use in a prominent Chicago hotel, where the people living in the hotel are called out to meet their friends at the entrance. This is done by placing several loud speaking telephones around each hall which are connected to a common microphone. This in turn is placed on a phonograph which contains the name of the party who is to be called. The name of the person is sounded in every part of the building until he answers, then the machine is stopped and made ready for another call.

EXPERIMENTAL CHEMISTRY.

(*Continued from page 422*)

boil as do other liquids. The nitrogen boils at a lower temperature than the oxygen (Nitrogen having a boiling point of -194 degrees, under the pressure of one atmosphere. Oxygen boils at -181 degrees, under the same conditions.) This permits a large proportion of the Nitrogen to escape ahead of the Oxygen, the latter being collected separately in the gaseous state.

5. By heating Lead Nitrate ($Pb(No_3)_2$), and other nitrates.

6. By heating Manganese Dioxide (MnO_2) in an iron tube with the high temperature of a gas burner. During this process only part of the Oxygen is separated, leaving behind another oxide (Mn_3O_4).

PROPERTIES OF OXYGEN.

Chemical Properties.

1. Oxygen combines readily with most elements to form oxides. (It does not, however, combine with Bromine (Br); Argon (A); Fluorine (Fl); or Helium (He.)

2. It is a supporter of ordinary combustion. (This is one of the chief chemical properties of oxygen.)

3. Sustains life by combining with the blood.

Physical Properties.

1. It is a colorless, odorless and tasteless gas.

2. It is 16 times heavier than Hydrogen.

3. A liter at Standard Temperature and Pressure (S.T.P.) weighs 1.43 gram.

4. It is slightly soluble in water. (100 cc. of water dissolves about 3 cc. of oxygen).

5. It can be liquefied and frozen.

6. As a liquid it is a pale steel-blue, transparent mass, and boils at -181 degrees (with the pressure of one atmosphere).

USES OF OXYGEN.

1. The main use of oxygen is the respiration of animals, fishes, etc.

2. As a general supporter of combustion, and in the laboratory as an oxidizer.

3. It is used to support life in subma-

MAGAZINE DONATES $10,000.

Our Readers May Profit by Generosity of Western Magazine Firm.

A well known Denver publishing house has appropriated $10,000 to be used solely in a whirlwind circulation campaign. Their offer is so liberal and the magazine so interesting that everybody is eager to send in their names.

The magazine referred to is 13 years old and each month publishes stories of adventure, numerous engravings and sketches of western life, cowboy capers, descriptions of famous ranches, irrigation projects, land news, rich gold mines, etc., and tells how and where to get homesteads. It is the oldest, largest and finest magazine in the west. Readers say it is worth $3, but in this surprising circulation campaign the publishers are spending their money like water and our readers may subscribe three whole years for only 25 cents, six full years for 50 cents. It is the biggest honest offer ever made. Remit in cash, postage stamps or money order. Tell all your friends. This offer may not appear again. Send today. Money back if not delighted. Mention the Electrical Experimenter and address **Rocky Mountain Magazine, Station 2, Denver, Colorado.** (Adv.)

rines; in diving bells; during balloon ascensions to a great height, and also for the respiration of deep-sea divers.

4. In medicine it is used for artificial respiration, or is administered to a person who has been suffocated; in cases of pneumonia, croup, asthma, or extreme weakness; for chloroform poisoning and in cases where other poisonous gases threaten death.

5. It is used with chloroform to produce an anaesthetic.

6. One of the chief commercial uses of oxygen is the Oxy-hydrogen blowpipe (see figure 20 "a" and "b"), which consists of two tubes as shown. The hydrogen is allowed to pass through the outer tube and combines with the oxygen (which is passed through the inner tube) under pressure and produces a blast, which is found to radiate intense heat. This flame is used extensively for cutting iron girders; for welding and for melting platinum and other highly refractory materials.

If a stick of quicklime is introduced at the tip of the flame, it does not melt, but becomes white-hot, giving an intense white light (similar to that of acetylene), which is known as the *limelight* or *calcium* light.

The Electric Vehicle Hand-Book. By Cushing and Smith. 400 pages; 161 illustrations; flexible leather covers; 6½ x4¼ inches. Price $2.00. Published by H. C. Cushing, Jr., New York City, N.Y.

Several engineers have contributed their experiences in compiling this book on electric vehicles. The idea of assisting the owners of electric cars to obtain the highest efficiency possible, has been carefully carried out.

Every phase of the subject was carefully considered and the best practice detailed in this book. Naturally, the construction, use and care of different types of storage batteries occupies the most space. The pages on battery charging give a full description of charging panels, rectifiers, measuring instruments and recording apparatus. Lead burning is described in detail with the apparatus used; also hydrometer readings; charging and discharging rates; also cadmium readings and their significance; motors, their mounting, connection and troubles; various types of controllers; care and handling of solid and pneumatic tires, etc., etc.

Owners of electric vehicles will welcome this volume, as it is a valuable guide for drivers and garage-men.

Oxy-Acetylene Welding and Cutting. By Harold P. Manly. 215 pages, 55 illustrations; cloth bound, 6¾x4½ inches, price, $1.00. Published by Frederick J. Drake & Co., Chicago.

This book is intended particularly for those whose duties bring them in touch with the actual work of welding and cutting with oxy-acetylene gas. The alphabetical index and accurate data will benefit the expert welder.

Metal, alloys and heat treatment, acetylene generators and auxiliary apparatus are covered before the real subject is taken up. Twenty pages are devoted to instructions on the preparation of the work, use of the torch, control of the flames and tables required in welding operations.

Beside gas welding, electric welding of different kinds, hand forging and other methods of joining metals—such as soldering, brazing and thermit welding—are explained. The last chapter is devoted to the oxygen process of removing carbon.

Laboratory Manual of Alternating Currents. By Lloyd C. Eddy, M.E., Ph.B. 81 pages; 21 illustrations; cloth bound; 8x5½ inches. Price 50 cents. Published by D. Van Nostrand Co., New York.

Among experimenters there is a noticeable lack of understanding concerning alternating currents. While this book was brought out to be used as a text-book, it will be very valuable to the student who wishes to try the simple experiments with very little equipment.

There are thirty separate experiments explained in an elementary way, covering the effects of choke coils, condensers, inductors, characteristics of transmission lines, delta or star connections, transformer regulation, and other subjects which must be understood before the more serious work is attempted by any student. It is one of the best books of its kind we have seen recently.

Mechanical Engineers' Handbook, based on the Hütte. By a staff of specialists. Lionel S. Marks, Editor-in-Chief. 1836 pages, profusely illustrated. Thumb indexed. Leather covers, gilt edges. Price $5.00. 1916. Published by the McGraw-Hill Book Company, New York City, N.Y.

The first edition of a new visitor in the realm of engineering hand-books. This pretentious volume will prove to be a fresh store of information to all workers in technical lines. A prodigious amount of labor has been expended in preparing this treatise of boiled down facts in order to make them easy of access to the engineer, yet replete with all necessary facts and data bearing on a certain problem. There are fifteen sections, thumb-indexed, covering the physical and practical designing considerations on most everything imaginable, from the flow of liquids through pipes to the stresses in a steel skyscraper frame.

Some of the important subjects treated upon at length are: Mathematical Tables and Weights and Measures; Mathematics (very complete, dealing with Geometry, Calculus, Graphical Representation of Functions, and Vector Analysis); Heat; Strength of Materials; Materials of Engineering; Machine Elements; Power Generation; Hoisting and Conveying; Transportation (including automobile engine and chassis data, load on tires, bearings, electric vehicle data, etc.); Building Construction and Equipment; Machine Shop Practice (details as to power required for driving various machine tools, heat-treatment of high-speed tools, industrial management, cost and other factory accounts); Pumps and Compressors; Electrical Engineering; Engineering Measurements; Mechanical Refrigeration, etc.

Then there are timely and practical sections on Gyroscopes, Oil Fuel for Boilers instead of Coal; Chemistry; Alloys and their composition; Foundry Operations; Ball Bearings; Gearing; Pulleys; Belts; Boiler Installations and Piping; Gas-power Plants; Gas Turbines; Turbine Design; Tidal Power; Cranes; Locomotive Performance; Track Lay-outs; Aeroplane Design (with formulae on wing pitch, air resistances, stability and propeller blades, also data on existing aeroplanes); Reinforced-concrete Construction; Steam and Hot-water Heating; Fire Protection; Molding Machines; Design of Air Ventilating Fans, etc., etc.

All in all, this book is a most worthy addition to our technical literature and a work that all those vitally interested in the subjects embraced should have at hand. Most books of this nature which include odd subjects tend to fall short on the necessary every-day data which they should contain, but the editors of this excellent book have certainly to be complimented on the thoroughness with which they have accomplished their task.

WIRELESS TELEPHONE IN ITALY.

Italians have maintained wireless telephone communication between Rome and Tripoli, a distance of 600 miles, mainly over water.

WITH THE "AD" MAN

Of course, my mail very frequently brings me in letters of unusual interest. Only the other day I received a complaint that *"The Electrical Experimenter"* was devoting too much of its space to advertisements.

Naturally, a statement of that nature strikes pretty close to home and I thought I would check up *"The Electrical Experimenter"* with some of the more popular fiction magazines now being published.

I was surprised to find that not only was *"The Electrical Experimenter"* devoting MORE space to actual reading matter and illustrations than those to which comparison was made, but I also found that we were giving twenty, and in some cases *thirty-three per cent more text* than practically 50% of the magazines on the market to-day.

Some day when you have a little spare or leisure time and you really are interested in seeing what a literary bargain you get, just compare the amount of space *"The Electrical Experimenter"* devotes to advertising and editorial matter with your next best favorite periodical and see what you get there for the same price.

I think you will admit that the balance is very much in favor of *"The Electrical Experimenter."*

MILTON HYMES.

LOOK FOR THE BIG SUPPLEMENT WITH THE NOVEMBER ISSUE
BETTER ORDER YOUR COPY IN ADVANCE

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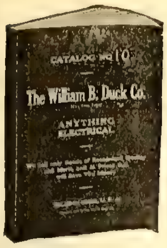
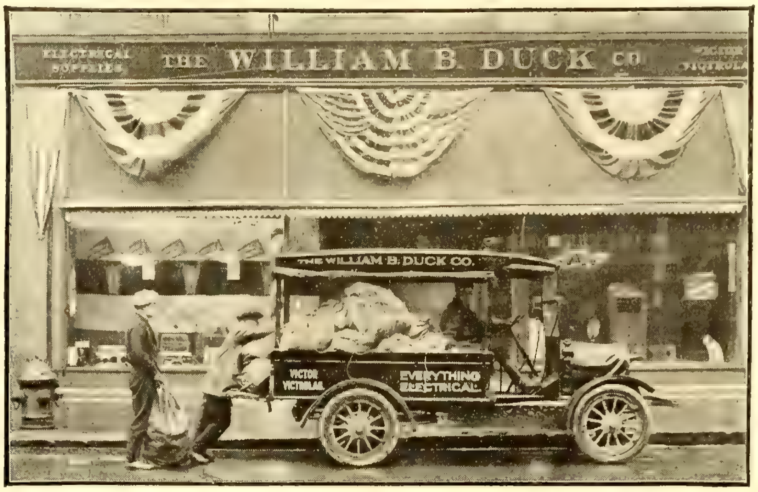


15,000 of our catalogs ready for delivery to eager electrical and wireless enthusiasts in all parts of the world. One of ten consecutive shipments of catalogs to our patrons during last November.



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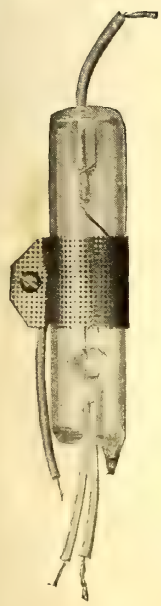
WHAT OUR BIG CATALOG CONTAINS

150 pp. Wireless Instruments, magnet wire of all kinds, raw material, storage batteries, telegraph instruments, battery motors, commercial motors and generators, sewing machine motors, telephones, step-down transformers, massage vibrators, bells, push buttons, auto accessories, flash lights, hand lanterns, auto and miniature lamps, Xmas tree outfits, voltmeters, ammeters, lighting plants, Victrolas, air rifles, electric aeroplanes, model builders, electric railways, electrical and mechanical books and general electrical supplies.

The William B. Duck Co., 230-232 SUPERIOR ST. TOLEDO, OHIO

The Moorhead Tube

Patent Pending



The MOORHEAD tube must not be confused with the two member valve, as it is inoperative without the outer electrode, or do not class it with the Trons or three member detectors as it is far more sensitive than either, in fact it is the most constant, stable and sensitive detector that has been developed.

A wonderful feature of the Moorhead tube is the static elimination. On the nights when static make the reception of stations with the ordinary detector impossible, the Moorhead tube brings the signals in with a marvelous clearness.

The initial cost of the Moorhead tube is low when the guaranteed long life is considered, and the fact that each Moorhead tube is a guaranteed

DETECTOR, AMPLIFIER and OSCILLATOR

SPECIAL INTRODUCTORY PRICE UNTIL JAN. 1, 1917

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233 Fulton Street, New York.

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Vol. IV Whole No. 43 CONTENTS FOR NOVEMBER, 1916 No. 7

Radium and Evolution

If we place a thermometer into a phial containing a minute quantity of Radium Bromide, it will indicate a temperature 2.7 degrees hotter than the temperature outside of the phial.

What the temperature would be if we substituted Radium for Radium Bromide, we have no means of knowing. For science has not as yet produced pure Radium, although the lay world prefers to think so. Our closest approach to Radium so far has been Radium Bromide, which *if pure* consists roughly of three-fifths by weight of the element Radium and two-fifths of the element Bromine.

Turning back to our thermometer we also make the discovery that the heat radiated from our speck of Radium Bromide does not grow less as the days and months, nay years and centuries, roll by. The mysterious element continues to furnish prodigious amounts of energy, with never a let up, or at least not until it has "worked" for 2,500 years—this being the present calculated age of Radium.

In order to better comprehend what this means, let us compare it with coal. This is what we find:

According to Professor Soddy, a gram of pure Radium evolves 133 calories of heat per hour. In one year (8760 hours) the same gram of Radium evolves 1,160,000 calories. In 2500 years—the length of time Radium will evolve energy—2,900,000,000 calories will be developed. Now, one gram of coal when burned evolves 2,200, *net*, calories of heat. Consequently, the energy developed by Radium is more than a million times that furnished from the combustion of coal.

Commercial Radium salts are at present obtained by working the Austrian Pitchblende and lately from the American Cornotite found in Colorado. These are practically the only commercial sources known today.

But Radium is by no means as scarce as most people believe. Radium emanations have been found in springs, in the air, in rocks, etc., and this has given rise to an extraordinary theory regarding the evolution of the worlds.

When the famous Swiss-Italian Simplon tunnel was constructed some years ago, totally unforeseen circumstances arose which made the work most difficult. Although this tunnel is far above sea level, the heat became unendurable as the work progressed. Artificial cooling had to be resorted to in order to allow the workmen to proceed with their work. Professor Joly then made the astounding discovery that the rocks of the Simplon contained Radium, which accounted for the unexpected high temperature within the mountain.

From this Joly has built up a new theory of evolution and while revolutionary in the extreme it is most plausible and gains more adherents each year.

Lord Kelvin already deduced that if the earth contained only two parts of Radium per million million—and a great deal more is actually found in the rocks and crust of our globe—this minute quantity would raise the temperature of the earth's core 1,800° C. in one hundred million years. There being no escape for the imprisoned heat—the earth's crust being an exceedingly bad heat conductor—Professor Joly convinces us that as the ages roll by, the interior of the earth must become hotter and hotter. Finally, after the end of millions of years, the crust must give way to this tremendous heat from within and the bursting earth must go up in flames, becoming a burning gas ball, just as we see our sun today.

This will be the "incandescent age," a title suggested by Professor Soddy. After another tens of million years the incandescent earth will have expended all of its heat into space by radiation and it gradually will cool. A new crust then begins to form anew. This is what we see at present on the planets Jupiter and Saturn, worlds just beginning to cool after emerging from their incandescent age.

Thus we find that worlds do not die. They slowly pass from one stage to another, in a long and interminable cycle. It is more than probable from the above that the earth must have passed many times through this cycle. Probably every time the world went up in flames, man was at his highest point of civilization, infinitely further advanced than we are today. In an instant every living soul had perished and for millions of years his like was not to tread again on the hardened earth crust.

This is the new and greater gospel of Radium, the element which will emancipate man and which will destroy him and his all later.

H. GERNSBACK.

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THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

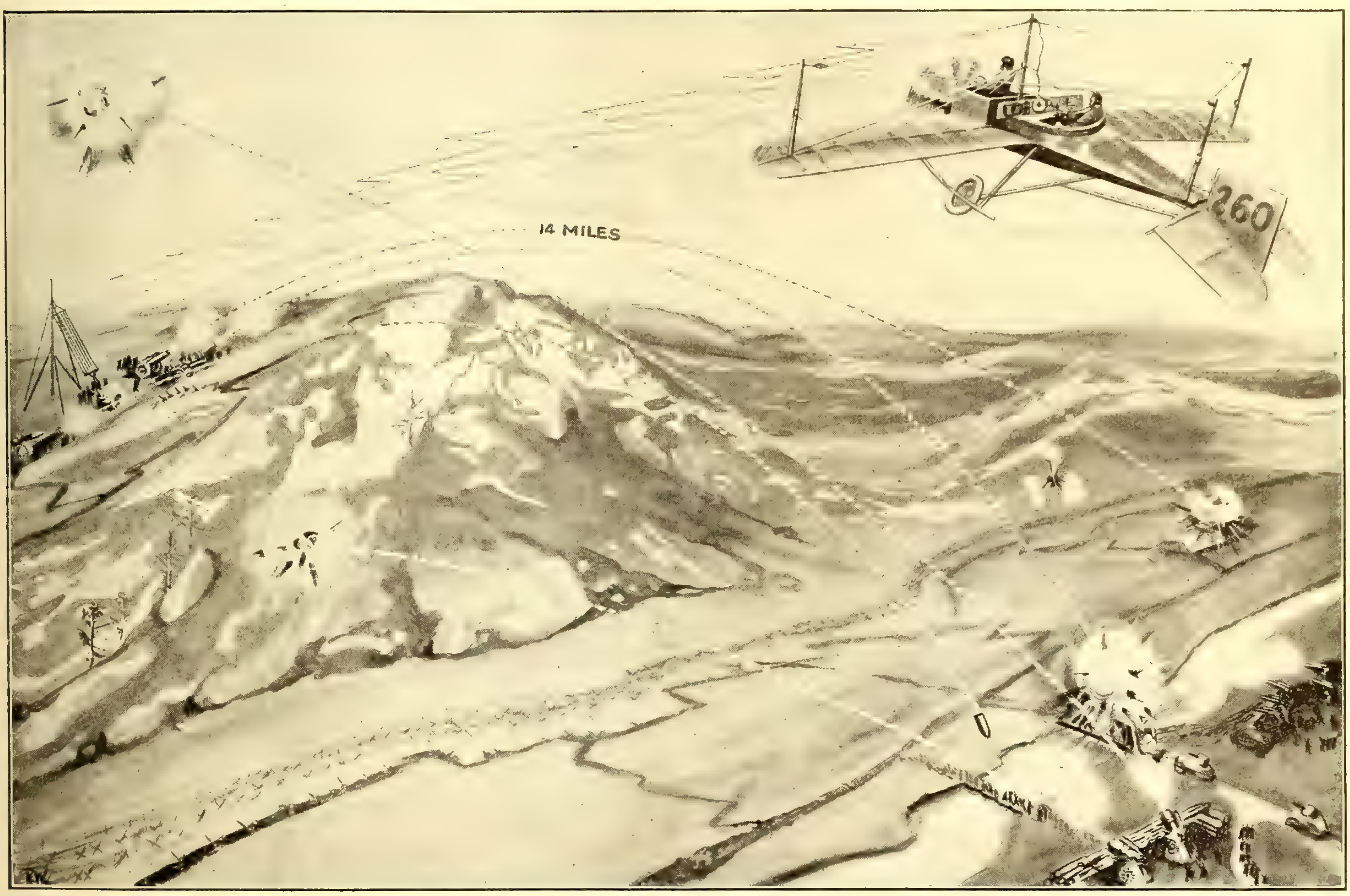
Vol. IV. Whole No. 43 NOVEMBER, 1916 Number 7

Wireless and Aeroplanes Aid European "Gun Spotters"

WHILE it has been considered for a long time in military circles that aeroplane wireless was certain to prove extremely valuable eventually, from all aspects, it is only within the past few months that we have heard anything definite in this direction.

The Allies, according to reports received from the battle-fronts, "somewhere in France," have found a number of ingenious uses for the radio equipped aeroplane. One communication with the distant *shell-spotting aeroplanes*. The high-powered battleplanes, each of which is equipped with a radio set capable of transmitting up to 30 or 40 miles, sail forth, and though they fly at a fairly great altitude, the aerial observers are quite able to accurately observe the resultant effects of the shell fire.

One of the reports states that a certain French battery of artillery actually succeeded in dropping four shells in succession on a bridge 14 miles away. The officers in the aeroplane helped to bring about this truly marvelous accuracy of fire by signaling back the exact effect of the bombardment to the commanding officer behind the French lines, via radio.



The French Gun Batteries are Reported to be Planting Successive Salvos on Points 14 Miles Distant, with Machine-like Accuracy. An Aeroplane Fitted with Wireless Apparatus Flies over the Enemy's Position and Signals Back the Result of Each Shot.

of these is to accurately locate (or "spot") and report the effect of shell firing over considerable distances, as clearly shown in the accompanying illustration. The manner in which this scheme operates in the instance reported is as follows:

Behind the French lines there is erected a collapsible radio mast and the proper signaling equipment capable of keeping up

While this scheme may seem hazardous in the extreme, especially where the enemy is plentifully supplied with modern anti-aircraft guns capable of hitting aeroplanes or Zeppelins at remarkable heights, it seems that the French aviators have a way of obtaining this most valuable information without undue risk to themselves or their machines.

Undoubtedly the aviator may now and then lose his life, or at least be captured by the enemy, but by flying at a great altitude it seems he has been able to safely obtain this much needed information and to signal it to the artillery officers, in a number of cases which are on record.

It goes without saying that in any such case as here cited, where the range is as great as fourteen miles, that those in charge of the guns cannot very well see the structure to be demolished from their position except in rare instances. It often happens that such firing is to take place over a hill, as shown in our illustration. Firing over

(*Continued on page 533*)

How Electric Current Controls Great "Movie" Battle Scenes

BEHIND the staging of a tremendous motion picture *battle scene* lie innumerable details of executive technical skill and in some of these electricity is depended upon for essential results. An instance of this is in the work of the *explosion man,* as he is called by the Photo-play directors. To him the use of a battery and wires and detonator is as important as to the engineer of any colossal public work. The only difference is that the movie explosion man's effects are theatrical instead of practical.

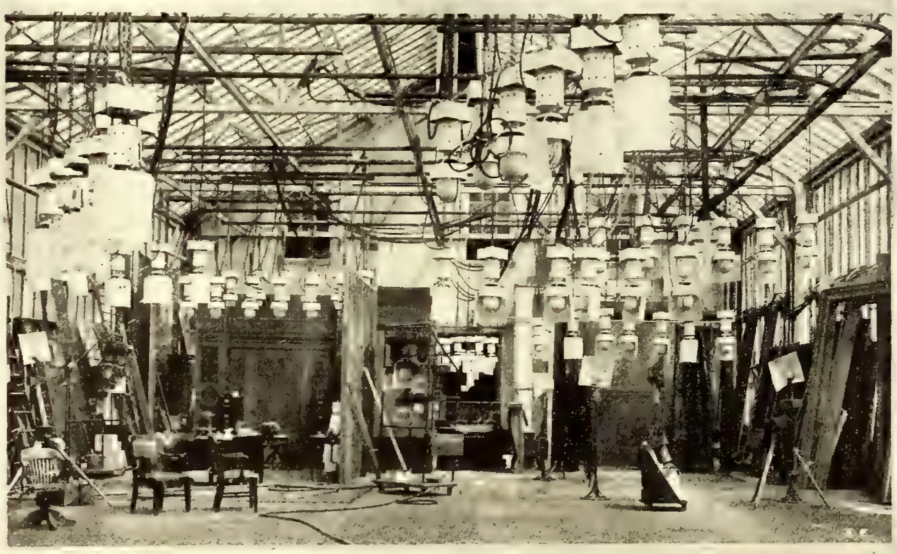
In the recent filming of a big battle scene in Commodore J. Stuart Blackton's "The Battle Cry of War" on Staten Island, the explosion expert, with his trusty little detonator, was a most important factor in the spectacular success of the action. Herman Rottjer, in charge of explosions for Vitagraph films, staged bursting shells, gas attacks and subterranean mines realistically with a touch of his finger on the electric key. Totally inconspicuous on the side lines of the battlefield, this expert executed explosions timed to the fraction of the second, and without the injury of a single person among the hundreds that charged and struggled across the terrain where scores of powder caches lay scattered. All this was managed successfully, ending with a climax of a mine explosion that consumed three hundred pounds of the explosive at once.

Amid a charging regiment small explosions that left shell craters three feet deep represented the shattering of shells striking the ground. In connection with these discharges bombs were simultaneously thrown into the air with a rapidity invisible to the eye, exploding about 200 feet above ground simulating shrapnel explosions. Then, here and there, heavier eruptions of earth gave the effect of mines. French mortars hurling bombs were also imitated cleverly, while rolling clouds of gas from nozzles in the defensive works gave a representation of the *real* thing in that line Here and there were mammoth 16-inch guns destroyed by internal explosions in a manner to suggest that an enemy shell had struck them fairly.

Another thing in which the indispensable electric detonating apparatus figured was the discharge of a battery of four regulation U.S. Army field guns, exactly timed to suit the psychological requirements of producer Blackton. These were not discharged by the artillerymen that stood around the guns. In this case the artillerymen merely went through the motions. A cool and practiced man in the background fired them with his trusty battery through wires connected to each gun. This was done in order that the action of the guns would be absolutely timed with the action of the scene, and for that it was necessary that one man only have control of all the discharges. This was executed delicately and in perfect harmony with the plan of the producer, with varying pauses between each flash—One-Three-Four-Two, by gun numbers.

The Two Upper Views Illustrate the Staging of a Battle Scene for the Film Play "The Battle Cry of War." A Mine Explosion Is Being Faithfully Duplicated in this Scene.

Below: One of the Few "Movie" Studios Utilizing Arc Lamps for Illumination.



A remarkable use of arc light illumination is that employed in the production of motion pictures at the Vitagraph studio in Brooklyn. In one of its glass-covered studios alone they employ 125 arc lights, all so arranged as to give maximum results photographically.

The matter for most comment in this application of arc lights is the fact that they are used alone and without any mercury tube lights as an adjunct. After long experimentation the company has found the best way to use these lights without employing the mercury vapor tube lamps. The studio experts utilize normal daylight as the blending medium. The satisfactory results from arcs can also be credited to an exclusive improvement in mounting the arcs, devised at this studio. The globe supports are such that no shadow is thrown by the supports upon the field to be photographed.

Another improvement incorporated in these lamps is the attachment of the rheostats directly to the lamps. In studio work this is an item of great convenience, since ordinarily the rheostats are separate from the lamps and installed on the walls wherein a maximum of wiring is involved to serve the outfit. About one hundred of these arcs are hung overhead in the studio on ten tracks, spaced ten feet apart. They can be moved about and concentrated easily anywhere, rheostats and all. The remainder of the arcs are disposed of in the form of twin-arc floor lamps on portable stands for *spots* and *ray* effects, or in the form of banks of six single arc lamps mounted on frames that may be rolled from place to place to serve as side lights. The floor lamps and the banks are fed with flexible insulated cables, and since they carry their own rheostats, are permissible for use at other locations where interior light for photography is required.

RHOTANIUM—NEW SUBSTITUTE FOR PLATINUM.

One of the latest scientific products of Yankee genius is an alloy known as *Rhotanium,* intended to substitute platinum. This composition is made up of several rare metals including polonium. Its specific gravity is about one half that of platinum and its cost is 50% less than platinum. The electrical resistance of Rhotanium is thirteen times the resistance of platinum, while the coefficient of resistance for changes in temperature is only one-third that of platinum. Due to the relative low cost of this new alloy it holds particular promise for use in the manufacture of crucibles and other chemist's ware for use in the chemical laboratory. It is expected to prove very desirable for use as a resistance element in small electrical furnaces such as those used in laboratories, etc.

JAMES CLERK MAXWELL.
November Marks His 37th Death Anniversary.

Born, June 13, 1831. Died, Nov. 5, 1879.

James Clerk Maxwell was born at Edinboro, Scotland, June 13, 1831. His parents, who were distinguished and well-to-do, were amply able to afford him every worldly advantage.

His chief characteristic, as a boy, was that he showed the most lively curiosity in almost everything that came to his notice. His bent was for securing accurate knowledge, and when any indefinite reply was given him, he would at once come back with, "But what's the particular go of it?" He was also a clever and industrious amateur experimenter, putting his questions directly to nature.

Studious and well-trained in the fine schools of the Scottish capital, young Maxwell early showed his proficiency in mathematics, making his first original contribution to that science at fifteen; for, in 1846, while he was still at the Edinboro Academy, the principal, Professor Forbes, read a paper before the Royal Society on *A Mechanical Method of Tracing Oval Curves,* written by his youthful pupil.

Shortly afterwards he entered the university, where he became an excellent student in mathematics and physical science. During this period he contributed several valuable papers. He graduated at the age of nineteen.

As he was fond of science, he entered the Trinity College, Cambridge, where he took his doctor's degree in 1854. The following year he started on a series of electrical and magnetic studies, which became the leading work of his life.

Maxwell's great work in electrical and magnetic philosophy consisted in gathering the vast store of experimental facts and observation on these subjects that had been accumulating so rapidly during the past hundred years, and weaving them into a workable theory, mathematically demonstrable, by means of which much of the observed phenomena could be explained and the relation between them better understood.

In this way he was able to go far beyond the experimenters' past performances, for he was able to make predictions based on his *theory* and its consequences—that certain things, when improved, would be found in nature to be so. Since then many of his predictions have been experimentally verified, while the developments of later years have profoundly changed our ideas on some of the subjects Maxwell treated upon.

James Clerk Maxwell, the Famous Scotch Physicist, upon Whose Mathematical Presumptions Hertz and Others Have Built the Radio Telegraph of To-day.

Perhaps the most famous instance of the wonderful insight possessed by this investigator is the case of invisible electro-magnetic waves. It was Maxwell who first demonstrated that these effects travel through space in the form of transverse vibrations, similar to those of light, but of much greater wave length and at the same velocity of light. Faraday had guessed this and Hertz proved by experiment that Maxwell's conclusions were correct. The whole science of radio-telegraphy and telephony has sprung from these basic and far-reaching facts. His grand conception was *that it is possible to account for all electric and magnetic action by supposing electricity and magnetism to be stresses and motions in a weightless material substance, called the ether.* As a consequence of this he showed that the ratio of the two centimeter-gram-second systems of electrostatic and electromagnetic units are numerically equal to the velocity of light in free space, expressed in centimeters per second, i.e., 30,000,000,000 cms., or 186,000 miles per second.

This achievement has well been called "the first great step towards the true understanding of the nature of electricity and magnetism."

All his activity of the first order took place in the compass of a short life. He

(*Continued on page 537*)

Electricity in the Treatment of Infantile Paralysis

The plague of infantile paralysis well-nigh succeeded in thoroughly alarming the entire country during the past summer. Hundreds of new cases sprung up overnight, as it were, and it seems to be the consensus of expert opinion that once the germs have started in their deadly work very little can be done towards alleviating the suffering of the unfortunate victim.

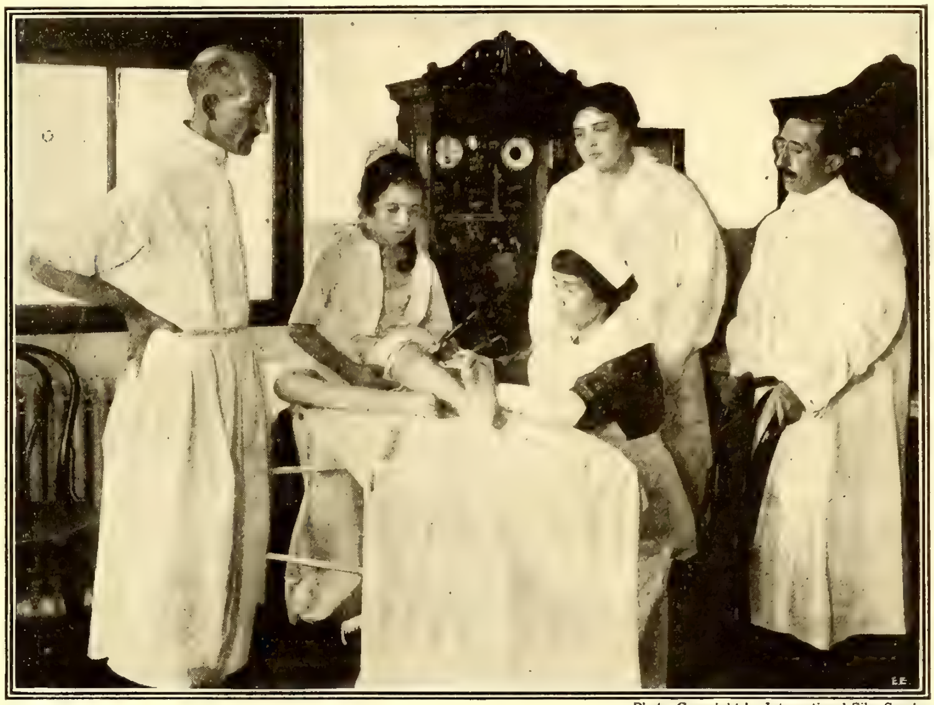


Photo Copyright by International Film Service

Electricity Has Helped to Alleviate the Suffering of the Thousands of Children Stricken with "Infantile Paralysis" and Here We See a Little Miss Receiving Such Treatment.

Some measure of success has been effected by spinal injections of blood taken from persons who have previously had the disease. However, there has to be a vast amount of muscular manipulation administered to those afflicted with the disease, and a great deal of good has been undeniably accomplished by this method of treatment.

Artificial stimulation of the muscles and nerves has been carried out in a number of instances at some of the leading hospitals by means of electric currents of the proper kind. The photograph shown herewith illustrates how electric current is applied to a child suffering from the infantile paralysis, the current being here applied through two dampened sponge electrodes. Various strengths of Galvanic, Faradic and sinusoidal currents are available from the elaborate switchboards shown in the background. These switchboards contain the necessary electrical measuring and controlling apparatus, so that the physicians and nurses can at once obtain any certain form of current.

Besides the direct application of electric currents of certain wave form and voltage for the relief of muscular paralysis, there are also available a number of special devices. There are motor-driven manipulating machines to which the patient's feet are strapped, and while they sit in a chair in front of the machine the apparatus works the limbs back and forth. In many cases there is permanent relief from what promises to be a serious case of muscular paralysis.

Professor Finsen, of the Finsen University, has successfully demonstrated that the ultra-violet light, produced by his arc light, which is of special construction, has the effect of curing infantile paralysis. It has also been shown that, by employing sunlight which passes through cobalt glass in such a manner that it is applied directly over the point where the paralysis is most acute, good results may be obtained in many instances.

It is hoped that in the near future our American physicians will start a thorough investigation with regard to the use of ultra-violet light for the curing of this perplexing ailment so little understood at present, both with respect to its causation, germination and cure.

The Telephone Valuable in Target Practice

THE telephone is doubtless the one instrument which performs more useful things than any other electrical device. It is now used in target practice and it has been found to be the most satisfactory means ever tried for signaling in this kind of work.

In the target pits are a number of iron frames, each equipped with two movable sashes, as indicated in Fig. 1. In the sashes are placed iron buzzer boxes equipped with buzzers and terminal strips. Midway in the pit, or at about the central position of all the targets, is placed a telephone box. This box is equipped with a bell that can be operated from any of the firing lines, two jacks for plugging in hand sets, and six push buttons. The push buttons are for ringing the bells mounted in the telephone boxes that are located at different firing lines. These firing lines are usually planned at 200 to 1,000 yards from the targets; Fig. 2 shows a squad firing from the 200 yard line. At each of these firing lines there is located a substantial cast iron telephone box. Each box is fitted with a bell that is operated from the telephone station located in the pit, two jacks for connecting a composite hand set, a push button to ring a bell at the station in the pit, and a number of similar push buttons for operating the buzzers that are installed in front of each of the targets in the pit.

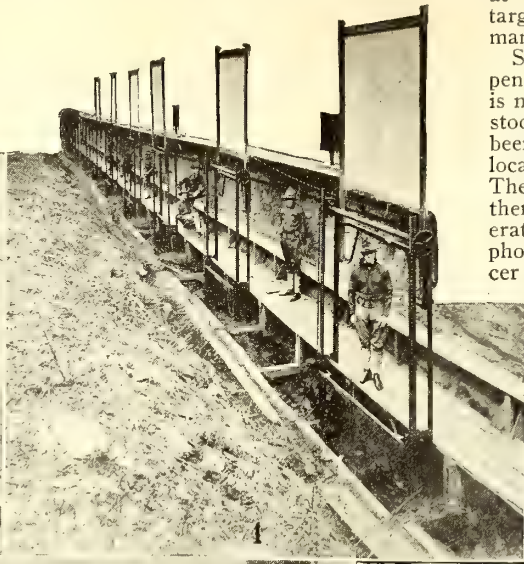
When a company or squad of men are on any of the firing lines for practice shooting or contesting for record marks, an officer is stationed in the rifle pit at the telephone station to communicate with the firing line. At each of the targets with its associate buzzer is stationed an attendant to answer the buzzer signals, checking the targets and registering the position of the shots fired at the target.

On the firing line the contestants for markmanship are assigned to their respective places in line with the targets they are to fire at. A man is detailed and stationed at the telephone box with a telephone handset plugged in. After firing, any one of the men may call to the man at the telephone to sash or mark targets Nos. 2, 4, 10, etc. The man at the telephone will push the corresponding number of buttons on the target called; the man in the pit hearing the buzzer immediately pulls down the sash with target and locates the shots. As one target is pulled down the one in the other sash automatically goes up, so that one target always appears above the pit. The result of the firing is signaled to the scoring officer and the men on the firing line by holding a disc over a like position on the target that is above the pit and being shot at. This target is in turn pulled down in answer to a buzzer signal and marked as in the first case. This alternating of targets is continued with every shot and carried on at each of the other targets in the same manner.

Sometimes it happens that the marking is not properly understood, or there has been an error in the location of the shot. The range officer will then instruct the operator at the telephone to call the officer in the target pit and instruct him to have certain targets re-marked, or to have any other information that may be desired communicated over the telephone. The officer at the telephone box on the firing line gets in touch immediately with the officer in the pit, to whom he gives instructions using the hand set described. When the officer in the pit desires to talk to someone on the range he pushes the button connected to the station desired. The operator at that point answers the call and procures the person wanted or delivers the message.

In some cases where the firing lines have quite a number of targets, say fifteen or twenty, it is found difficult to call out to the man stationed at the telephone the number of the target to be signaled. When this is the case, plugs are inserted in jacks with their signal conductor running out to the man on the firing line. One of these is illustrated in Fig. 3. These men can then do their own signaling by touching the end of the conductor to an iron rod driven into the ground. This feature is shown by the cords from the telephone box to a protecting cover on the ground. When not in use these conductors are coiled up and put away with the hand set. This interesting equipment was installed for the Georgia State Militia at Augusta, Georgia, by the Western Electric Company.

Every day sees some new application of the telephone to the wants of mankind.



Militia Using the Telephone for Checking Target Scores at Augusta, Ga. 1—The Target Pits; 2—Officer and Telephone Operator at Firing Line; 3—A Closer View of the Firing Line Telephone Operator Communicating with the Target Checkers.

STATUE TO PROFESSOR JOSEPH HENRY.

A bronze statue to Professor Joseph Henry, whose name is intimately associated with the invention of the telegraph, is to be erected at Albany, N.Y., for which purpose funds are now being collected. Among the members of the honorary committee are Dr. Alexander Graham Bell, Theodore N. Vail, Thomas A. Edison, Dr. M. I. Pupin and Dr. J. J. Carty.

TELEPHONE CORDS TO BE WHITE.

The shortage of dyes, due to the European war, has been felt in practically all American industries. And now it is beginning to seriously affect the telephone business.

The pair of jumper wires used on the main frame formerly consisted of one white and one red cord. But in future they will consist of one white cord and another white one with a couple of red threads woven through it.

UNION OF GERMAN TECHNICAL ASSOCIATION.

A "Verband" of the principal German technical associations has been formed under the name of the Association of German Scientific Societies. Those societies comprising the "Verband" are the Institution of German Electrical Engineers, the Institution of German Engineers, the Institution of German Architects, the Association of Blast Furnacemen, the German Chemical Society, and the Association of Shipbuilding Engineers. Headquarters are in Berlin. The "Verband" will thus represent 60,000 members of the different professions involved. One of the principal results which is looked for from the combination is the furtherance of the work of finding substitutes for the raw material hitherto obtained in neutral countries or those with whom Germany is now at war. What a fine chance for a "successful" alchemist, who could turn lead into copper, and silver into gold.

New Electric Devices Help the Housewife

POSSIBLY the latest attempt to retain the labor-saving advantages of electric cooking on a large scale, and at the same time to reduce its cost, may be seen in the combination gas-electric range. This interesting novelty is equipped with a "fireless-electric" oven while gas is retained for the burners at the top of the stove. It is too soon to speak authoritatively of the merits of this device. Certainly, however, it promises well.

The electric range has come to stay. When properly used they not only represent the acme of flexibility and cleanliness but economy as well. Some of the ranges are equipped with automatic time-switches which cut off the current at the end of any desired prearranged time. In this way the mistress or cook may start a roast on the electric range and, having set the time-switch for the proper time period, she may go out and do her shopping. The roast will be done to a turn when she returns.

Also it is possible to set the thermostat to constantly maintain the proper temperature. Baking, roasting and boiling can be done in this way. When the proper temperature is reached, which requires ten minutes to half an hour, depending upon the temperature required, the current automatically cuts off and from then on cooking proceeds as in a fireless cooker. The heavy heat insulation about the walls of the oven—two inches of rock wool—causes the ovens to retain their heat for hours. No attention is required until the hour arrives at which it was determined the meal should be ready.

With the new electric range, breakfast can be prepared in the way just mentioned the night before with the assurance that it will be ready exactly on time.

Cooking processes that do not require much time and for which the food can be prepared in advance are performed on the stove top. For this purpose the electric range has two 8-inch and one 10-inch radiant heaters, each with a special three-heat indicating control switch. In the combination gas and electric ranges, the stove top is provided with four gas burners, one of which is of extra large size with a small, specially controlled simmering burner in the center. All the burners can be lighted instantly by means of an automatic gas lighter controlled by a valve at the front of the stove, which normally burns a very small pilot flame.

It is claimed that better cooking results can be obtained in the electric ovens than in a gas oven, owing to the fact that two heaters are provided, one at the top and the other at the bottom with baffle plates to provide a uniform distribution of heat. Pastry can be browned just as in any other kind of range. It is also claimed that food shrinks less in these electric ovens than in a gas oven, owing to the more flexible application of the heat and the fact that the oven is entirely enclosed except for a small ventilating pipe.

The portable electric serving table mounted on wheels has come into vogue of late. One of these is shown herewith. They may contain several necessary devices such as an electrically heated chafing dish, a coffee percolator, tea-pot, a dish warmer, a stew-pan, etc. A flexible attachment cord enables the hostess to connect the serving table to a convenient base or floor plug receptacle.

Then, too, the up-to-date electric housekeeper can invoke the aid of the genie, Electricity, to whip the cream, shave the ice, mix the cake or bread dough, sift the flour, beat the eggs, chop meat, slice potatoes or fruit, polish the silver, wash the dishes, et cetera. Just snap the switch and—Presto—the magic current starts to work. Unlike the human servant, it never becomes tired. It is satisfaction itself.

Of electric refrigeration for household purposes, one can now say that it is a fact. Machines to accomplish this work are now being produced, and it is said that the manufacturers are still busy supplying the advance orders for their machine. Like other electric power devices, the arguments for it include cleanliness, convenience and low operating cost. As a medium of refrigeration it possesses two special advantages, the extremely small temperature variation, impossible to secure with melting ice, and the fact that the machine also produces ample ice for table use, about twenty pounds in the course of twenty-four hours.

Indeed the modern housewife is faced with an embarrassment of riches where electric appliances are concerned, and one great difficulty lies in deciding where to begin. The best plan is for the prospective purchaser to study her own situation and discover where its weakest spot lies. Undoubtedly she will find some machine designed to overcome that particular difficulty. And that is the point at which she should begin the electrification of her housekeeping. *Photos courtesy New York Edison Company.*

Photo at Right (top) Shows one of Latest Household Conveniences—a Portable Electric Serving Table on Which There is a Percolator and Table Stove. A Flexible Cord and Plug Connects the Serving Table with the Nearest Base Receptacle.

Lower Right Hand View Illustrates a Very Complete Electric Kitchen with the Magic Current Performing All the Work from Broiling a Steak to Washing the Dishes. Even the Refrigerator Ice Is Electrically Produced.

Photo Below Shows New Electric Range Equipped With Time-clock Attachment and Thermostats to Maintain Even Heat and also to Cut off the Current at any Predetermined Time.

WIRELESS FROM GIRL IN CALIFORNIA HEARD IN LYNN, MASS.

The message, "Hello, Massachusetts; how are you?" vibrating its way across the country from San Raphael, Cal., was picked up by Gustave A. F. Werner with his wireless receiver in the Highland first station, Lynn, recently.

The message was sent by Miss Kathleen G. Parkin, fifteen years old, one of the youngest girl wireless operators in the country. She signed the query and added her address.

Werner immediately replied, "First rate, thank you."

She is a member of the American Radio Relay League, to which organization Werner also belongs. Miss Parkin and her work were described in the last issue of this journal.

An electric apparatus for washing smoke has been perfected to relieve cities of the smoke nuisance. The smoke is driven by fans through a column of water which washes out the soot and cinders. Pittsburgh papers please copy!

Lightning Made to Order

By Samuel Cohen

ONE of the most perplexing problems that scientists have attacked during recent years involved either the harnessing or imitation of the forces of Nature. Many of our greatest scientists in all parts of the globe have spent fabulous sums and years of patient study on such problems, but most of them have signally failed; a number of eminent scientists even claim that such conundrums will never be thoroughly solved.

This, however, appears, in our present day, to be highly doubtful. As early as 1890 Dr. Nikola Tesla undertook to solve the problem, and some years later succeeded in demonstrating to the world that it is quite possible to imitate certain natural dynamic forces on a scale of surprisingly vast magnitude.

Most of us know that *Lightning* is a natural electrical discharge taking place between two adjacent clouds, each having been charged with electricity of opposite polarity. As soon as they approach sufficiently close, the electric potential between them becomes so terrific that the air strata between is ruptured, thus producing a vivid spark, followed by thunder, which is caused by the sudden rush of air into the evacuated space produced by the electric discharge. Lightning may be caused also by a discharge taking place between a cloud and the earth. The process by which the clouds are electrically charged is still a mystery, and we must wait until some future genius will explain to us the exact phenomena that takes place in the upper atmosphere, where such electrical disturbances take place.

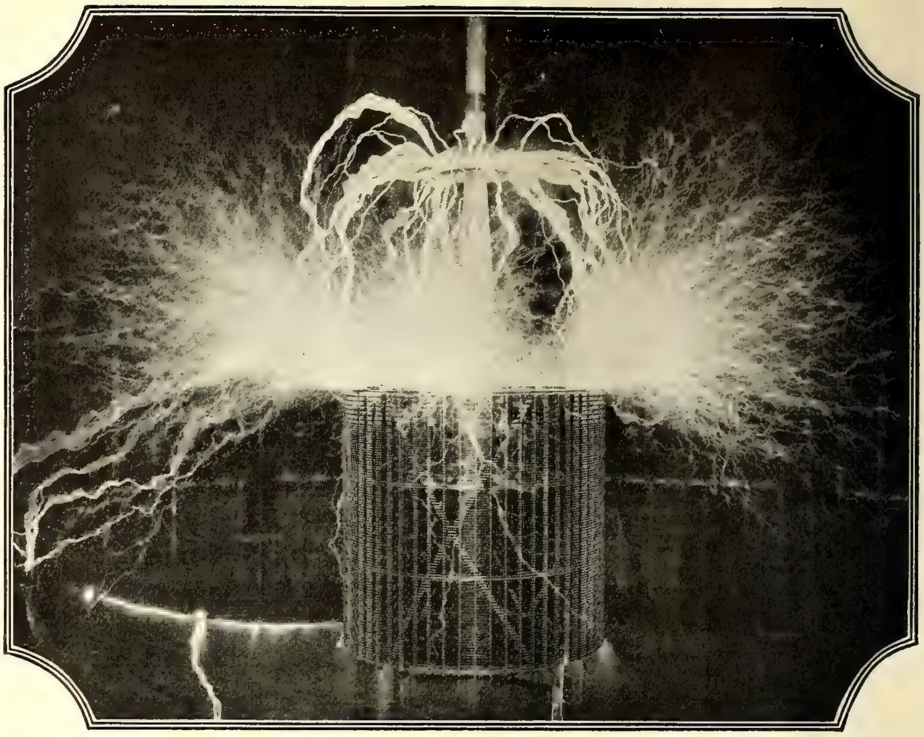


Fig. 1. The Wonderful Tesla, 300 K.W. High-Frequency Oscillator Coil in Full Activity, Discharging Sparks Like Veritable Bolts of Thor and Measuring 65 Feet Across.

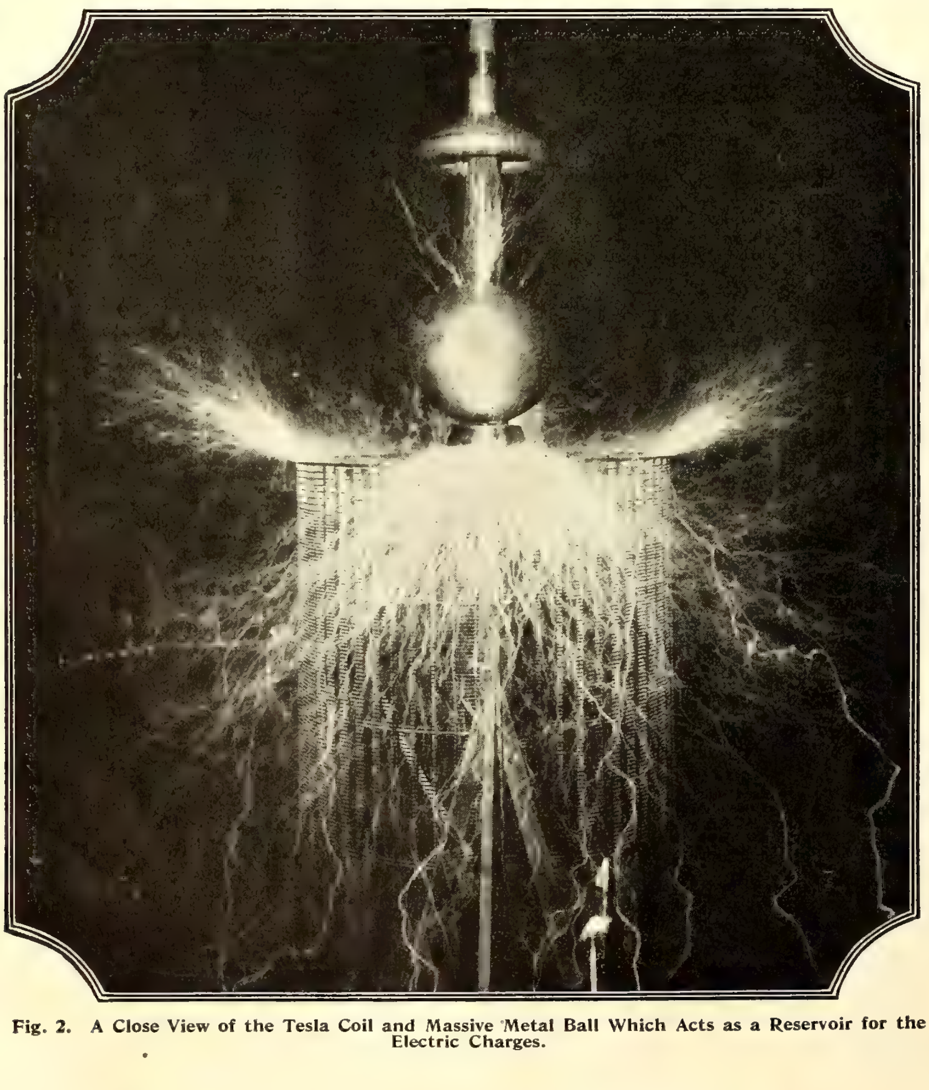


Fig. 2. A Close View of the Tesla Coil and Massive Metal Ball Which Acts as a Reservoir for the Electric Charges.

Dr. Nikola Tesla, who is perhaps the greatest living authority on alternating currents of both high and low frequency, has performed some of the most marvelous experiments ever dreamed of with high potential, high frequency currents. As early as 1890 this savant had produced electrical disturbances in his laboratory at Colorado Springs equal to the lightning produced by Nature. Although a number of years have elapsed since these experiments were conducted, not a single scientist or engineer has been able to produce such awe-inspiring, electrical performances as did Dr. Tesla. It is true that he is far ahead of his time in many of his inventions, yet he has ably demonstrated that it is possible to imitate some of Nature's secret forces. It should be noted that his sole purpose was not simply to imitate these forces, but he was performing certain experiments on the problem of radio transmission of electrical energy through space. The startling *lightning* effects here shown were produced during the course of these experiments.

During a recent interview the writer had with Dr. Tesla, the photographs herewith reproduced were kindly loaned to accompany this article. Two of these photos were never shown to the public before. Our front cover, painted by Mr. George Wall, is an exact reproduction in colors corresponding to Fig. 1. The man was seated near the apparatus solely for the purpose of showing the relative size of the high frequency oscillation coil. The photograph was obtained by double exposure; that is, the plate was exposed with the man, while the apparatus was not in operation; then he was removed and another exposure made of the sparks on the same plate, as it would not be very healthy for anyone to be there when the experiment is conducted.

In Fig. 1 we see the Tesla electric oscillator in full activity at twelve million

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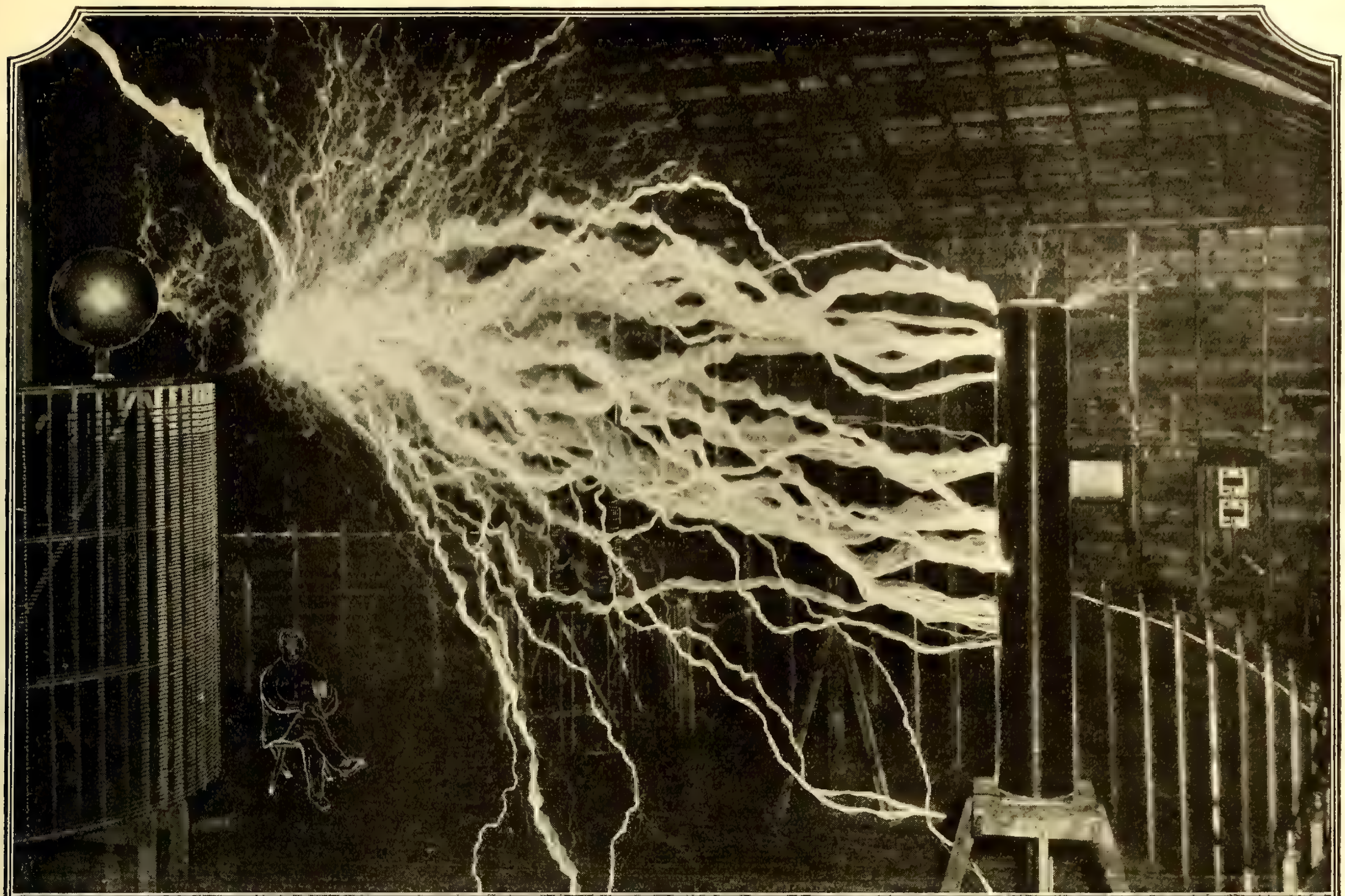


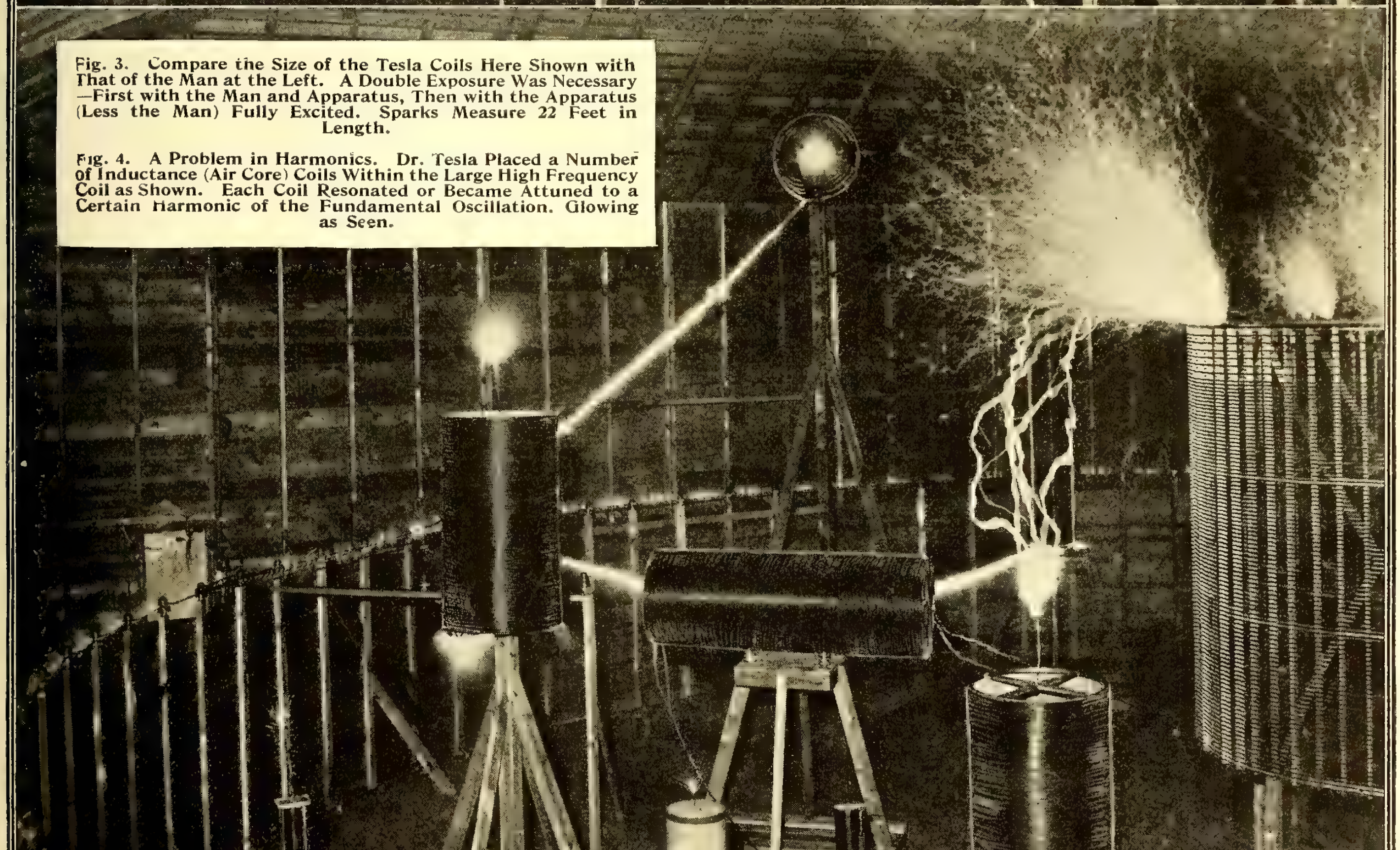


Fig. 3. Compare the Size of the Tesla Coils Here Shown with That of the Man at the Left. A Double Exposure Was Necessary —First with the Man and Apparatus, Then with the Apparatus (Less the Man) Fully Excited. Sparks Measure 22 Feet in Length.

Fig. 4. A Problem in Harmonics. Dr. Tesla Placed a Number of Inductance (Air Core) Coils Within the Large High Frequency Coil as Shown. Each Coil Resonated or Became Attuned to a Certain Harmonic of the Fundamental Oscillation, Glowing as Seen.

Remarkable Electric Illumination of Outdoor Theatrical

The illumination and lighting effects of the mammoth outdoor pageant *Caliban,* a Shakespearean Masque, recently produced in the stadium of the College of the City of New York, were remarkable in being the most elaborate system of lighting ever witnessed in a dramatic performance in America. It marks special interest in the replacing and proof of superiority of the high power nitrogen-filled incandescent lamp projector over the arc lamp.

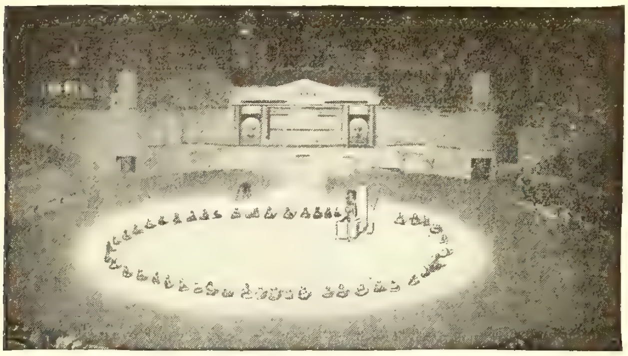


Fig. 1. Flood Illumination of the Huge Central Ring at Mammoth Outdoor Theatrical. The Distance from the Nearest Flood Light Projector to Center of the Ring Was Over 200 Feet.

The magnitude of the lighting problem is appreciated when the immense outdoor areas to be flooded from great distances is considered. The circular stadium has a seating capacity of 20,000. The immense stage shown in Fig. 1, is 80 feet long, 40 feet high and 20 feet deep, and at a distance of over 300 feet from the spot and searchlight tower. At the height of the illumination incandescent lamps and projectors drew 1,100 amperes from the alternating current lines, while searchlights and arc-lamp spot lights drew 30 amperes from the direct current power station of the City College.

Fig. 2. One of the Daylight Flood Reflectors, Fitted with 1000 Watt, Nitrogen Filled, Incandescent Lamp, Focusing Device and Boomerang or Colored Slide Holder.

The action passed through three stages. In the large 100-foot diameter ring in the center of the stadium, 1,500 trained amateur actors and athletes presented, in action, ritual and dance, the art of the theater in Egypt, Greece, Rome, France, Germany, Spain and Elizabethan England. Directly in front of the stage proper was a large, dragon-like form of cave, around which much of the action centered and which was finally removed or seemingly transferred by lighting effects into a theater represented by the stage proper. The lighting consisted of general illumination during the entrance and seating of the audience. White flood lighting and vari-colored flooding of the different settings, illumination of the stage, with scenic effects, invisible illumination for the musicians located over the stage and the light screening or cutting out of the stage from the view of the audience, during the arrival.

In spite of the extremely large areas to be flooded with light, now bright sunlight, and then shading off into different colors and cutting out portions of the scene entirely, was accomplished to the wonder of the spectators.

All the illumination and lighting effects being produced by incandescent nitrogen-filled lamps, the lighting was controlled from a single switchboard back of the stage, the stage manager communicating his orders to the distant light operators and ordering color changes by means of an elaborate telephone system. So perfect was the central control that the lights glowed mysteriously here and there during the performance—the color of illumination varying according to the scene.

The light for the general flood illumination came from five sources of special light towers. Fig. 2 shows one of the daylight flood reflectors, batteries of which were located on the arcade of the stadium, high above the audience, the distance from these lights to the center of the ring being something over 200 feet. These flood reflectors, especially designed for this production, contained 1,000 watt nitrogen-filled incandescent lamps with high-power reflectors and a special light shield to conceal the source of light from the audience opposite. Two banks of these lamps furnished general illumination for arrival and departure of the audience from the grounds and during the performance the full battery was used for flooding the central ring, and vari-colored effects were secured by a boomerang or quick-change color slides. A bank of these lights concealed on either side of the stage flooded the stage towers with blue light. Two 18-inch searchlights and three 50 ampere spot lights, practically the only arcs used in the production, served only for spot illumination of principal figures and individuals.

One of the newest and most novel lighting features was the curtain of light. During the arrival and seating of the audience, several 1,000-watt, glass-lined reflectors were placed before the stage settings. These reflectors directed toward the audience produced a mild blinding in the direction of the stage, thus acting as a complete screen or *curtain of light.*

Special lighting for the musicians above the stage and the chorus of 300 singers was accomplished by thirty, eight foot strips of blue lights, without interfering with the illumination of the general performance. The lighting effects and special lamps for this production were designed, installed and engineered by the Universal Electric Stage Lighting Co., of New York City.

EDISON IN BED THREE HOURS IN 15 DAYS.

Thomas A. Edison recently went on another "spree." His is a sleepless spree and the one in question was termed by members of his "insomnia squad" in the inventive wizard's laboratories, as one of the greatest he ever ventured forth on. During fifteen days Mr. Edison worked all night. The fatigue of all night labor was offset by an hour's sleep each morning after breakfast. The inventor is in his sixty-ninth year and still going strong.

THE OLDEST "HELLO" GIRL.

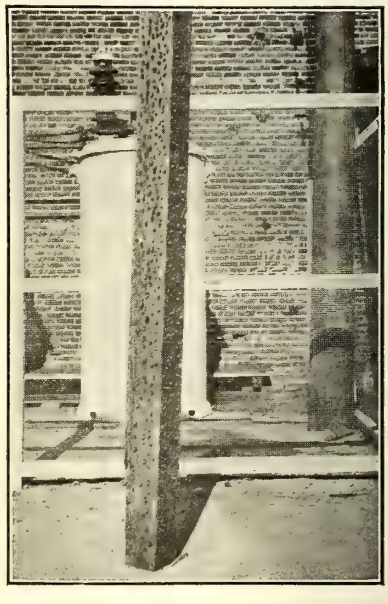
At the Linkville exchange, just outside of Kansas City, Harry Moore, aged 72 years, and his wife, Anna Moore, aged 66, plug in on the switchboard to answer calls and give connections. They give day and night service and love the work. Though Mr. and Mrs. Moore are well along in years, subscribers never have to complain about the lines being busy, for their service is always prompt and cheerful.

These operators know every man, woman and child in their community, and they know every subscriber's number. One of them is always at the switchboard. The story of these oldest operators in the world, who never receive a complaint on the service, might be read with profit by the youngest operators in the world.

Mrs. Moore knits and darns at the switchboard. Her spectacles rest on the lower ridge of her nose. Her gray hair is done up tight on her head. She is the chief operator and her husband is her worthy and faithful assistant.

WOODPECKERS ATTACK ELECTRIC LIGHT POLES.

Certain kinds of birds are fond of boring or pecking holes in trees and poles. A redwood pole on the Hanford line of the San Joaquin Light & Power Company in southern California recently had to be replaced because of the activity of the birds in using it as a storehouse for winter food.

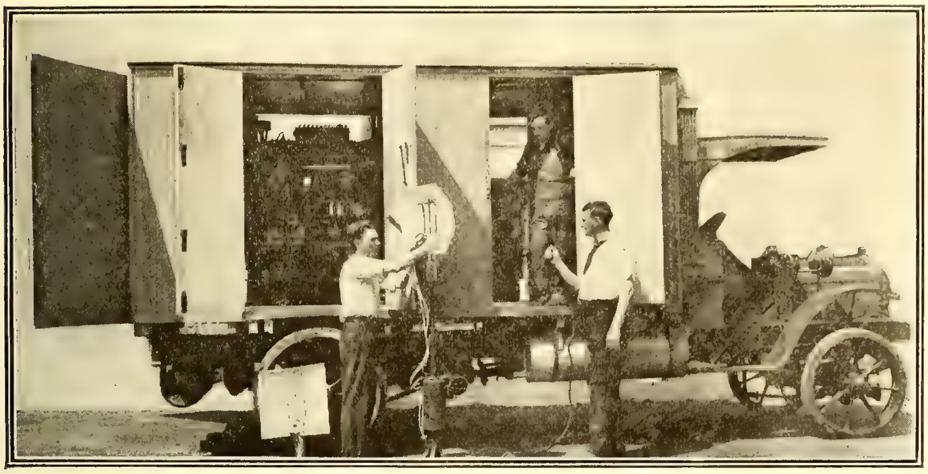


The Woodpecker Is a Busy Bird. If You Don't Think So, Just See How He Decorated This Electric Pole with His Bill.

The accompanying illustration shows a section of the pole which contained many hundreds of acorns. This particular pole had been in service seventeen years. The base had been oiled but the part above ground was untreated. It should be explained in connection with this that only poles of soft wood, which have long been exposed to the weather, are attacked in this way, and then only rarely to an extent that makes trouble for the power companies. By far the greater portion of the damage s done by woodpeckers, although several other kinds of birds, native to California, ometimes attack wooden poles. In Mexico and other countries it has become imperative that steel poles be employed, owing to the fact that worms and other pests persist in drilling holes in and through them.

Movie Concern Builds Portable Electric Plant

ONE more unit has been added to the great fleet of motor-cars in the extensive garage of the Vitagraph Company. This time it is a dynamo car to provide a portable lighting system for motion-picture photography. The car, one of huge proportions and large capacity, was built in the company's own garage from designs made by its experts. It is now in successful operation.



For Photographing Night Scenes in Isolated Districts One of the Leading Movie Producers Designed This Portable Gasoline Engine and Dynamo Plant.

Such a car has long been needed, because at many outdoor locations in the more remote sections of Long Island, where it is desired to take motion-pictures at night, there is no nearby electric line that may be tapped for current to supply the powerful arc lights. The need for facilities became more urgent after the great production of "The Battle Cry of War" was begun, sequel to "The Battle Cry of Peace."

The dynamo car consists of an enclosed van-like body mounted on a 5-ton truck, the stripped chassis of which was the foundation for the vehicle. The propulsion motor is a White gas motor bought with the chassis. In the body as built are two separate compartments. In the front one, which is the smaller, is a dynamo of 218 amperes and 120 volts rating. The rear compartment contains a five-cylinder, marine gasoline engine of 50 H.P. at the rather high speed of 750 revolutions per minute under load. The entire body is lined with galvanized iron for fire proofing and heavy rubber mats on the floor serve for electrical insulation. The body can be closed entirely to the weather.

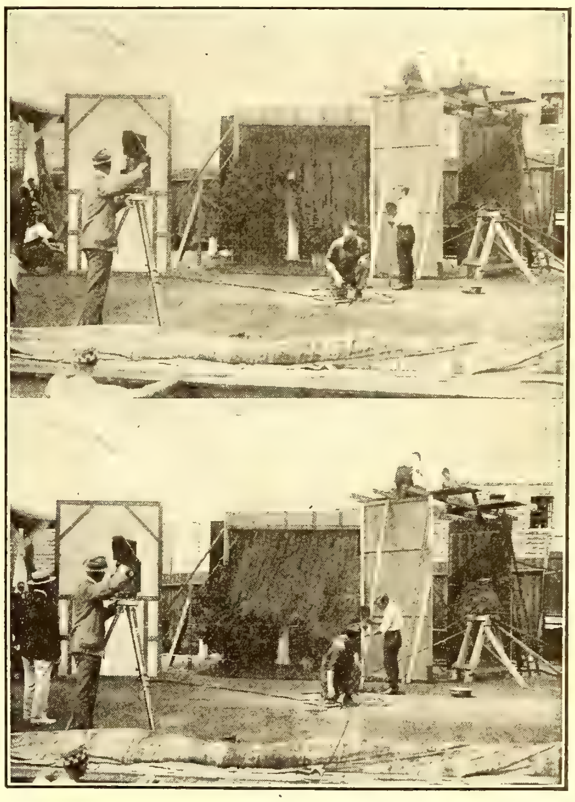
The studio arcs used for taking film action indoors are of various sizes, consuming usually about 28 amperes and 12-15 amperes. The dynamo on the car not only developed a full capacity for such lamps in the outdoor work but produced a highly satisfactory quality of light.

ELECTRICALLY MADE THUNDER-STORMS FOR THE "MOVIES."

We sit at a "movie" watching our favorite actor or actress performing all kinds of didoes, from jumping off a cliff to being electrocuted in the electric chair not thinking perhaps that electricity plays many hundred secret roles every day at the motion picture studios, from creating a beautiful tropical sun-set to an entrancing moonlight scene. It is up to the stage electrician to solve many of these problems, some of which could hardly be arranged for at all, if it were not for the great flexibility with which the electric current in its many forms, readily adapts itself to a hundred and one new problems

Fig. 1 (top) shows the stage set for a thunder-storm scene from the Thanhouser-Pathé photo-play—*Saint, Woman and Devil*—featuring Miss Florence La Badie. The rain is falling heavily as created by allowing water to fall in a thin sheet or curtain from the tank above the setting. Fig. 2 (bottom) shows the rain storm in full swing. The propeller at the right is driven by the electric motor seen at the center of the stage, and while rapidly revolving, the stage hands above the propeller empty several sprinkling cans of water on it. This results in a *driving rain* being blown against the rain curtain already falling. The actors do not get wet as they stand behind the falling sheet of aqua pura. The photos show the settings only.

An electrically ignited flash-powder charge, carefully manipulated, is passed across the scene at the proper moment, apparently shattering the large vase. The vase is sure to be shattered—never fear—for the reason that it is secured to a string held by a nearby stage attachee, who cheerfully yanks it asunder at the psychological moment.



It's Raining in the "Movies." Above We See the Pouring Rain and Below—A "Terrific" Wind, Created by an Aeroplane Propeller Which Drives the Rain Toward the Left.

TUNGSTEN PRODUCTION SETS NEW RECORD FOR THE UNITED STATES.

The tungsten production of the United States during the first six months of 1916 exceeded the production of this or any other country in any previous twelve months. Prices were even more phenomenal than production and reached more than ten times their ordinary level. The output was equivalent to about 3,290 short tons of concentrates carrying 60 per cent WO_3, valued at $9,113,000, according to an estimate made by Frank L. Hess, of the United States Geographical Survey. California is one of the chief tungsten producing states.

SILVER CAN BE MAGNETISED.

By H. J. Gray.

It was discovered in the course of some experiments conducted upon the Newtonian constant of gravitation, described in a paper read before the Royal Society in December, 1915, that silver is capable of being magnetized under certain circumstances. Bars of very pure silver were heated to 130° C. and kept in a strong magnetic field, and it was afterward found that they had become permanently, though weakly, magnetised. This curious result, which is really an offshoot of experiments directed to quite a different end, reminds us that magnetism is not a property peculiar to iron, any more than radio-activity is peculiar to radium. Iron and nickel are chief magnetic metals.

ELECTRICITY IN THE LAUNDRY.

The use of electricity in the laundry has been making steady progress, but its usual application is in driving motors and heating irons and mangles. The extension of its use for electrolysis represents one of the latest applications which promises to improve the laundering process, reduce the cost, and add to the load of the central station. There should be many opportunities for introducing this process in all cities.

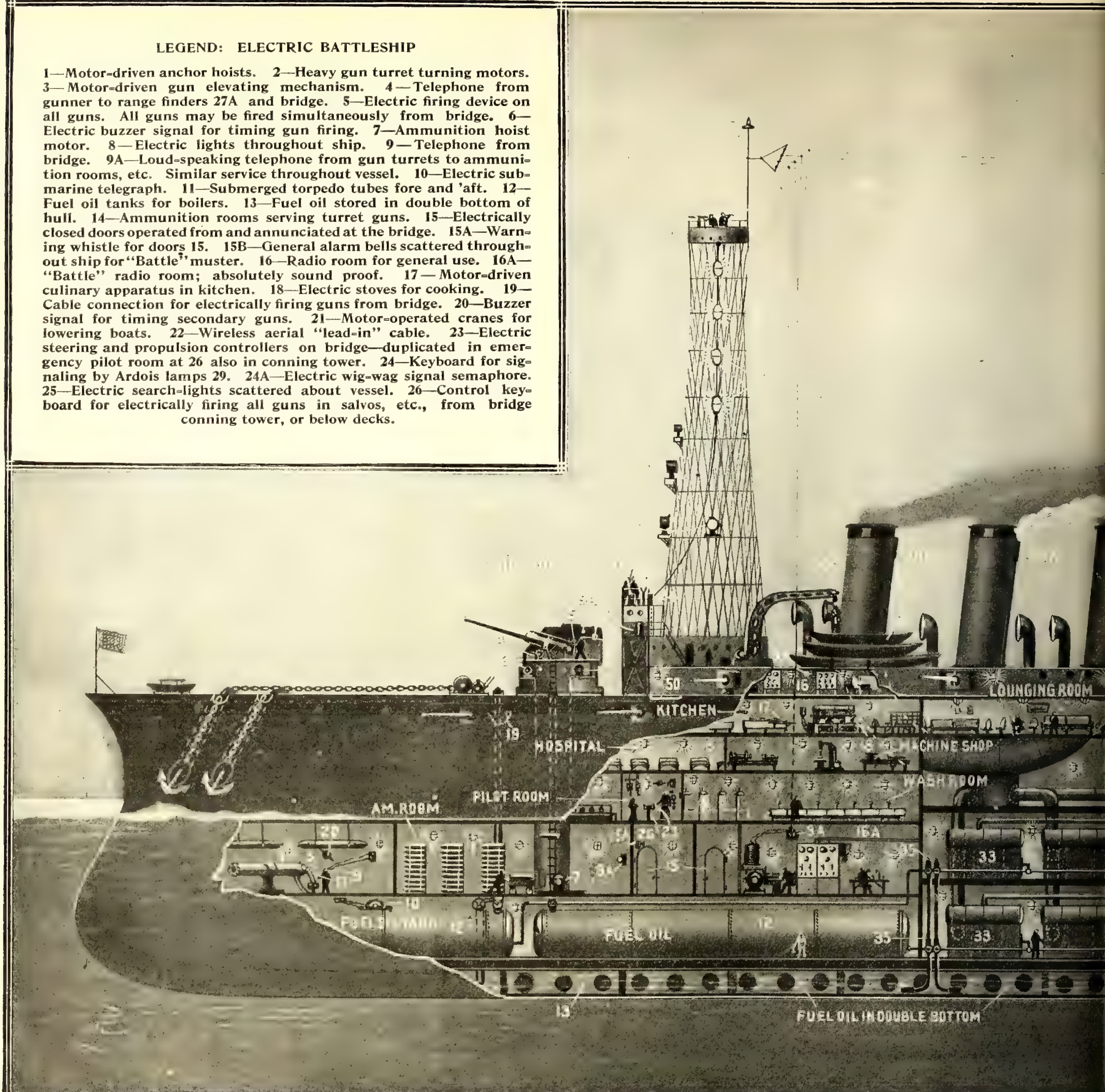
A notable application of this process on the British hospital ship *Aquitania* has recently been reported. In that case ordinary sea water is used as an electrolyte and the resulting product is applied not only in the laundry, but also in the swimming bath, for various disinfecting purposes about the ship and for surgical use. It is also applied for the purification of drinking water, one part in one million sufficing in this case. The electric sad iron has also proved to be extremely efficient.

German engineers are using zinc wires in place of copper, which is required for military purposes.

Electrically operated locks are now fitted on automobile doors. Pressing a button opens the door.

LEGEND: ELECTRIC BATTLESHIP

1—Motor-driven anchor hoists. 2—Heavy gun turret turning motors. 3—Motor-driven gun elevating mechanism. 4—Telephone from gunner to range finders 27A and bridge. 5—Electric firing device on all guns. All guns may be fired simultaneously from bridge. 6—Electric buzzer signal for timing gun firing. 7—Ammunition hoist motor. 8—Electric lights throughout ship. 9—Telephone from bridge. 9A—Loud-speaking telephone from gun turrets to ammunition rooms, etc. Similar service throughout vessel. 10—Electric submarine telegraph. 11—Submerged torpedo tubes fore and 'aft. 12—Fuel oil tanks for boilers. 13—Fuel oil stored in double bottom of hull. 14—Ammunition rooms serving turret guns. 15—Electrically closed doors operated from and annunciated at the bridge. 15A—Warning whistle for doors 15. 15B—General alarm bells scattered throughout ship for "Battle" muster. 16—Radio room for general use. 16A—"Battle" radio room; absolutely sound proof. 17—Motor-driven culinary apparatus in kitchen. 18—Electric stoves for cooking. 19—Cable connection for electrically firing guns from bridge. 20—Buzzer signal for timing secondary guns. 21—Motor-operated cranes for lowering boats. 22—Wireless aerial "lead-in" cable. 23—Electric steering and propulsion controllers on bridge—duplicated in emergency pilot room at 26 also in conning tower. 24—Keyboard for signaling by Ardois lamps 29. 24A—Electric wig-wag signal semaphore. 25—Electric search-lights scattered about vessel. 26—Control keyboard for electrically firing all guns in salvos, etc., from bridge conning tower, or below decks.



Uncle Sam's New 40-mile an Hour "Electric" Battle-Cruiser

By H. Winfield Secor and Arthur C. Doyle*

The most wonderful fighting ship ever built by any nation is about to be constructed for the U. S. Navy. It will speed over the seas at over forty miles an hour. The armament will be of the best, the main battery comprising eight 16-inch guns of the highest power, besides numerous smaller calibre guns. The electric power plant driving the propellers will develop 175,000 H.P., sufficient to operate all the New York Subways.

WHILE the foreign powers are busily engaged in a titanic struggle for the supremacy of Europe, Uncle Sam's naval engineers have been also busily engaged, though in a somewhat different way. The results of their calculations and researches have brought forth plans for one of the mightiest fighting craft ever dreamed of, even by naval constructors. In short, these new ships, four of which have been authorized to be laid down next year, will resemble huge blast furnaces gone to sea. From their six massive smoke stacks there will belch forth reeling black smoke from 175,000 H.P. in boilers. These ships will be designed with special regard to the shape and finish of the hull, which will have a length of nearly 900 feet. The beam of the vessel will be 97 feet, and their full load displacement about 40,000 tons. These marvelous ships, the greatest of their kind ever designed, are scheduled to attain a speed of 35 knots with full equipment aboard. And the naval experts are in hopes that they will tear through the sea at 38 knots or more, stripped. This velocity of travel is equivalent to about 42 land miles per hour.

These latest bull-dogs of the sea will be electrically driven and their boilers will be of the oil-burning type. It has been specified that they shall be so equipped that they can steam along without giving off any smoke from their stacks, when it is desired to conceal their movements. They are to be so arranged that when desirable, for maneuvers, heavy banks of thick, black

*(Formerly Chief Electrician U.S. Navy).

26A—Signaling lamp on forward mast head. 26B—Speed signaling lamp on 'aft mast head. 27—Telephone on head of range finding officers on masts and other points communicating with gunners and bridge stations. 27A—Range finding telescopes on masts, etc. 29—Ardois signaling lamps operated from keyboard on bridge at 24. 30—Smoke stacks for boilers. 30A—Electrically controlled steam "Siren" and "Fog" whistles. 30B—Electrically controlled maneuvering whistle. 31—Electric launch. 32—Main flue to smoke stacks. 32A—Motor-driven washing machine in laundry. 33—Oil burning boilers. 34—Air-spray oil burners in steam boilers. 35—Air pumps for lifting fuel oil from double bottom or tanks. 36—Air compressors (all motor driven) for oil spray burners, etc. 37—Steam turbines driving electric generators 38. 39—Main electric distribution switch-board. 40—Remote control switch-board linking bridge with propeller and rudder motors, et cetera. 41—Electric propeller motors controlled from bridge (23), conning tower or pilot room below decks. 42—Propeller shafts. 43—Evaporator plant (motor-driven), producing drinking water from sea water. 44—Motor-driven fans to circulate fresh air through lower decks of vessel. 45—Fresh air funnels supplying fans, etc. 46—Helm or rudder motor controlled from bridge (23), conning tower or pilot room below decks. 47—Electric helm indicating switch device; shows by numbered lamps at 23, exact position of the rudder. 48—Two "Battle" wireless antennae supported on both sides of warship, thus giving 3 aerials in all. 49—Microphone system for detecting submarines. 50—Electrically released self-illuminating buoys. Push of a button throws them into the water when man falls over-board.

smoke can be rolled out of their stacks, forming a veritable cloud bank or screen to conceal the operations of other war vessels behind them.

The general arrangement of the electrical and other equipment upon these wonderful examples of modern naval architecture, is shown in our accompanying wash-drawing. Some idea of the vast size of the power plant, or, rather, the vast amount of energy required to be developed by the power plant, may be had by comparing it for the moment with the horse-power developed by such a central station as that supplying electric power to the City of New York. When these monster craft develop 175,000 H.P. they will then be producing 25,000 H.P. more than the grand total put out by the Fifty-ninth Street Power Station of the New York Edison Company, this station operating the whole New York Subway system.

The General Electric Company will install the turbo-electric generating equipment as well as the electric motors, which are di-

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Another important item is the fuel to be used under the boilers. This will be petroleum or other oil of similar thermal value. And besides that carried as reserve, in tanks, a large portion of the oil fuel will be stored between the two steel skins of the double bottom of the hull. The very latest type of specially designed and extremely compact water-tube boilers will be fitted with highly efficient, compressed air

(Continued on page 533)

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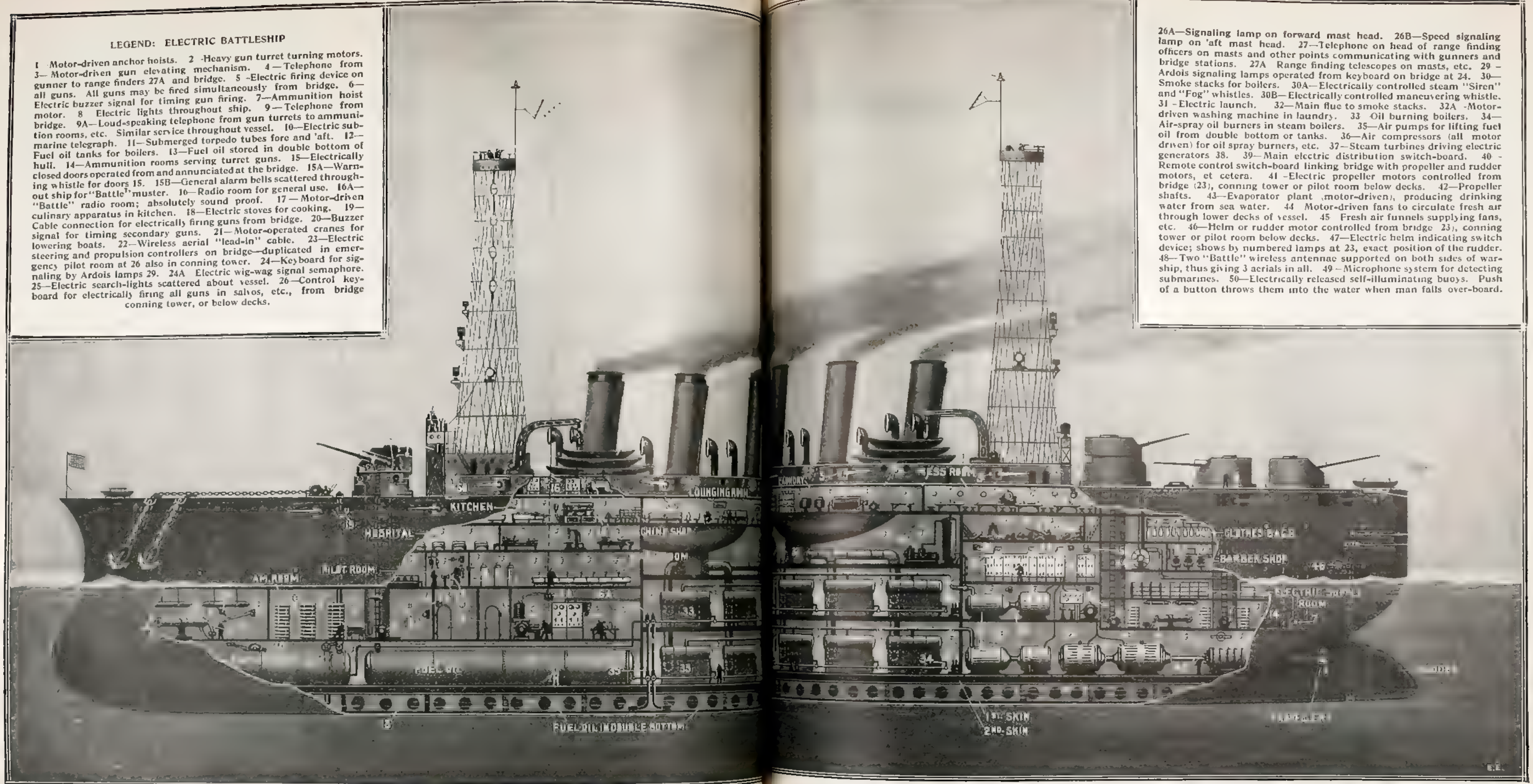

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(*Continued on page 533*)

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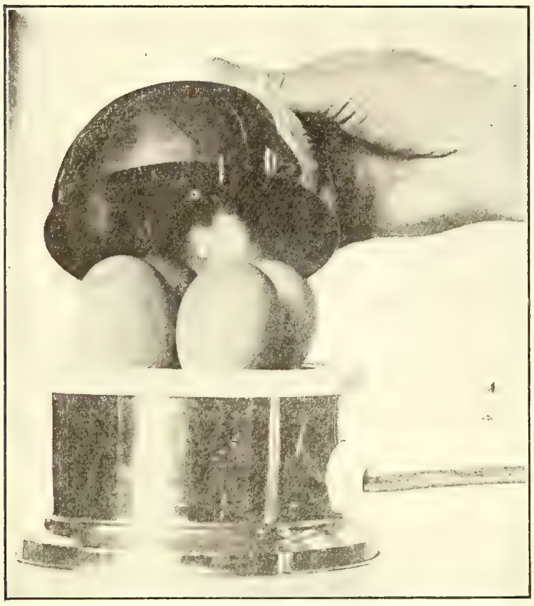
COOKING EGGS BY ELECTROLYSIS

An ingenious electrical cooking device has recently appeared, which, among other novel features, does not make use of heat



The Latest Device for "Cooking" That Great American Breakfast Essential—the Egg. The Hen-Fruit Are Steamed, Not Boiled, and This Is Said to Make Them Extremely Edible.

developed in resistance wires, but instead steam is formed by the passage of current directly through a small quantity of water in sufficient quantity to cause the water to boil. This device is used principally for cooking eggs, and in this connection the use of a graduated quantity of water will allow of a regulation of the degree to which the eggs are cooked, without any further watching; the circuit breaking automatically when the water has been boiled away. The cooker is so arranged that it will cook the eggs to the same extent, whether there is one egg or more and whether the eggs are large or small.

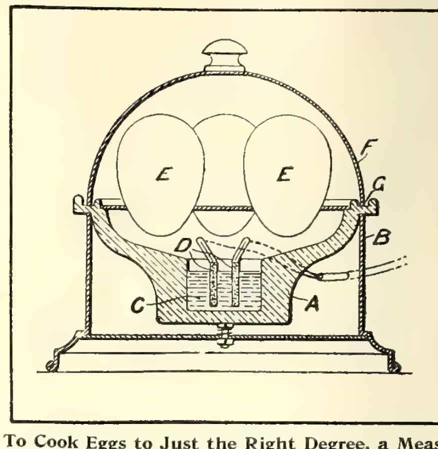
A description of this device will make these points apparent. A porcelain dish, A, is held in a nickel plated base, B, by means of a special bolt. The porcelain dish has a small well, C, located in its center and in which the two carbon electrodes D are placed. The cover, F, sets in the groove, G, of the dish, A. This groove is of sufficient capacity to hold as much water as the well, C, will hold.

The eggs, E, are placed in a perforated metal holder. A separable plug is connected to a flexible cable which leads the current to the two carbon electrodes.

The operation is as follows: A measured quantity of water is placed in the well from a measure. The measure is filled up to the desired point by covering one or more of the holes with the fingers, thus determining the degree to which the eggs will be cooked, whether soft, medium, or hard. When the current is turned on a sufficient quantity flows through the water and the carbon electrodes to cause the water to boil almost immediately. The resistance of the water is materially reduced by the carbons, which contain sufficient salts to insure satisfactory operation at all times. Salt should therefore never be added to the water.

For the uniform cooking of different size or different numbers of eggs it will be apparent first of all that the amount of steam condensed on the surface of the egg will be approximately proportional to the amount of heat absorbed by the egg. Thus, when steam first begins to form, the eggs are cold and will absorb a great deal of heat and the condensation on their surface will be great. It is obvious that a large egg with a greater surface will condense more steam than a smaller egg. Now, as the eggs are placed directly over the sloping sides of the bowl, all this condensed steam will run into the well and will be evaporated by the heating action of the electric current. On the other hand the steam which is condensed on the inside of the cover will run down into the groove G and remain there. Therefore, when the eggs have become heated to the point where condensation no longer takes place on their surface, the water in the well will boil out and be condensed on the cover, meantime, cooking the eggs to the desired point. Finally, the water will all be boiled out of the well, thus automatically turning off the current just when the eggs have reached the desired turn to suit the individual taste for which the water measure was set.

It is interesting to note that not more than 1½ teaspoonfuls of water need be



To Cook Eggs to Just the Right Degree, a Measured Quantity of Water Is Placed in the Lower Receptacle C. Ebullition Is Produced by the Electric Current Passing Thru the Water; Finally All the Water Condenses on the Cover F, and Into Groove G, Thus Cutting Off Current.

boiled to cook four eggs, as compared with the kettle full that used to be necessary. The economy of this must be obvious. Furthermore, no one who has eaten eggs cooked by steam will ever want to eat the old fashioned boiled eggs again it is claimed. The whites are never tough as they are in boiled eggs, but always tender and delicious.

This same device when used for warming babies' milk is a household convenience that fills a long felt want. It is impossible to burn or scorch the milk and it is unnecessary to watch it while it is warming.

Other possibilities for this form of electric heater are being developed, as it is apparent that it can be applied for all sorts of steam cooking as well as warming liquids and sterilizing material by steam.

AN ELECTRIC LAMP FOR THE MICROSCOPE.

The lamp here illustrated is constructed to throw the light either on the mirror or directly up through the condenser of the microscope. It gives illumination sufficient for oil immersion work. It is small and compact yet very efficient and is neatly finished in black crystal lacquer. No light can escape except through the single opening. It is equipped with a 10-watt Mazda tungs-

A Miniature Electric Lamp which Gives Effect of Daylight for Microscopic Requirements.

ten bulb, and works on any 110-volt circuit. It can be used on 220-volt current when placed in series with proper resistance. The microscope lamp is supplied with blue and ground, and *Daylite* glasses; the latter, when placed in front of a nitrogen-filled tungsten lamp, gives a white light having the same color and spectral energy distribution as natural daylight.

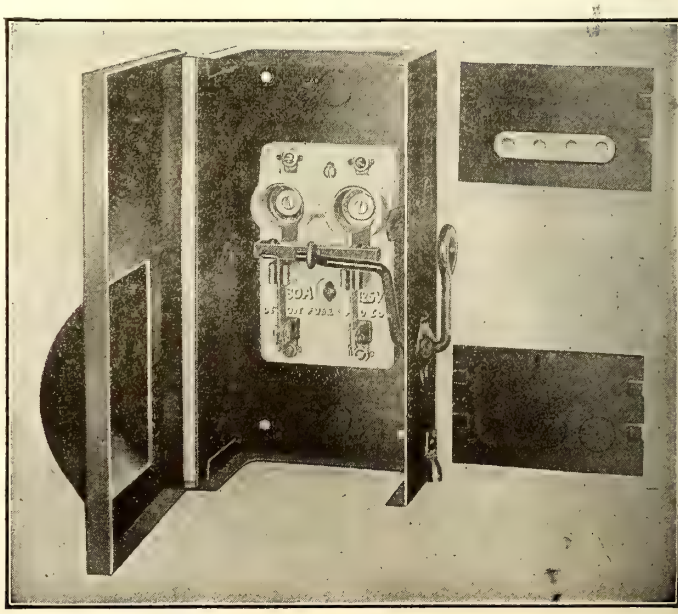
A SHOCK-PROOF SWITCH FOR "SAFETY-FIRST."

Each year the newspapers print accounts of accidents resulting from the use of the open type switch widely used in industrial plants. Often such accidents go unrecorded, but were it possible to make an accurate accounting the total would probably be surprisingly great.

The *enclosed switch* here illustrated offers a complete remedy for the open switch evil.

The switch and cutout unit are completely enclosed in a metal box provided with a hinged cover which is held closed with a simple spring catch. The switch is operated by a crank handle located outside the box. It may also be locked in the *off* position to prevent accident when repairs are in progress. Means are also provided to lock or seal the cover shut to prevent unauthorized persons overfusing the switch or tampering with *live* connections.

Photo *Western Electric Co.*



A "Safety-first" Electric Service Switch which Can Be Locked in the "Off" Position.

Charles Proteus Steinmetz—This Month's Supplement

CHARLES PROTEUS STEINMETZ, the subject of our photographic supplement with this number of THE ELECTRICAL EXPERIMENTER, is perhaps the most widely known electrical engineer in the Western hemisphere, and his fame has spread to practically all parts of the civilized globe.

In his official capacity, Dr. Steinmetz serves as Chief Consulting Engineer of the vast General Electric Company's works in Schenectady, N.Y.

This accomplished scholar and technician, whose name is practically a household word in the United States at least, started his career in a very inauspicious manner; and yet again, some would call it a very auspicious manner.

He was born in Breslau, Germany, in 1865, and when he grew up he associated with a number of the most radical Socialists in Germany. In fact, he was placed in jail with a number of Socialists, but as nothing could be proved against him, he was released. One thing led to another however, and so it came about that he became what Americans term "an undesirable citizen," at least from a German political viewpoint. The upshot of these matters was that Dr. Steinmetz, then a young man, withdrew to Switzerland and eventually came to the United States.

It was in the year 1889 that this seemingly very ordinary young man reached New York in the steerage of a French steamship. He carried letters of high recommendation from his professors at Breslau and the Polytechnische in Zurich, but his pockets jingled not with the coin of the realm, or, at least, not above a few dollars.

He finally procured a position as draftsman, which, although opening excellent channels for his intellectual proclivities, did not prove of sufficient scope for applying the vast knowledge which he had accumulated in the subjects of mathematics, physics, chemistry and medicine.

The company with which he had become associated in the capacity of draftsman was finally absorbed by the General Electric Company, and it was not many years before Charles P. Steinmetz had made a name for himself; in fact, such a name that he was appointed head of the Consulting Engineering Department of the Company. This was but five years after he had reached America.

The name of Steinmetz is synonymous with *mathematics* to most people who know even the least bit about him, and he himself has said that he attributed all of his success and advancement to his excellent knowledge of mathematics.

He takes active interest in various phases of educational work and serves as president of the National Corporation of Schools. This association aims to give industrial training to grade-school boys in order that they may be able to gain sufficient technical educational to enable them to hold positions of responsibility with greater remuneration than that accorded to the unskilled.

Also Dr. Steinmetz has a class in electrical engineering at Union College, and this Institution gave him the degree of Doctor of Philosophy in 1903.

Some idea of the responsibilities and important work performed in the electrical field by this peer of electrical engineers may be gained from the fact that he receives the largest income ever paid to anyone in a similar capacity, which amounts to $100,000 a year.

Dr. Steinmetz is very short in stature and somewhat stooped. He is always ready to talk on any subject owing to his extremely broad education. And he still believes in Socialism—even for Americans. He is said to have but one suit and to wear no hat at all—true Socialism. His interviewers invariably find him puffing away at a long black cigar.

With his manifold duties as Chief Consulting Engineer to the mightiest electrical corporation of all time, he has found an opportunity, in his spare moments, to write a number of electrical books which have become *classics* in the science of electrical engineering. Ask any electrical engineer or electrical expert as to what books he considers the most valuable in his library and he will answer you in one word—Steinmetz!

WITH THE DECEMBER ISSUE

we will present another

SUPPLEMENT

of a famous radio inventor. This is the second of a series promised to our readers.

These supplements are printed on fine art paper, ready for framing. They are invaluable to adorn your den, your wireless station, or your laboratory.

Order your copy now, to make sure you will get it.

A FARMER PUZZLES THE TELEGRAPH EXPERTS.

Up in northern New York during last August a farmer with good intentions, but slight knowledge of the characteristics of the electric fluid, created a lot of trouble for the board attendants and quad men of the Western Union Company at New York, Syracuse, Watertown and Ogdensburg, says *Telegraph and Telephone Age*. At a point where the poles carry half a dozen or more of the principal wires that terminate at Ogdensburg, the farmer wished to pass under the wires with a load of hay, but found that his load was too high. He solved his difficulty by encircling all of the telegraph wires with a piece of his own wire used in binding bales of hay. This he drew tight, raised the obstruction and drove on, leaving his "tie wire" in place for the benefit of other farmers who might wish to pass that way with loads of hay.

This happened shortly before noon. Business between New York and Ogdensburg stopped suddenly. The wire experts soon developed the worst "cross" they had ever met with. Upon opening all but one of the circuits they could work through the remaining one after a fashion. Selection at random was as good as using the same wire at both ends, provided all the other circuits were opened.

This state of affairs lasted until the middle of the afternoon, adding gray hairs to the heads of the experts and emphasis to their remarks. Suddenly normal conditions returned. Later in the day the lineman's report cleared up the mystery.

LITERALLY.

"Here are a lot of suggestions from outsiders as to how to run this newspaper. See that they are carried out," said the editor.

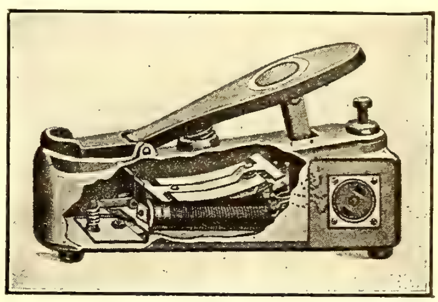
"Yes, sir," said the office-boy, and, putting them all in a waste-paper basket, he promptly carried them out.

PRESSURE OF FOOT CONTROLS THIS SEWING MACHINE MOTOR.

The women folks like handy devices, especially electric devices—but above all else, they must be simple and efficient. This applies particularly to electric drives for sewing machines; a large variety of speeds are very desirable for such work, but the ordinary rheostat used for controlling the motor current gives only a few variations in speed at best.

The Harder You Press on this Foot Rheostat the Faster the Motor Runs.

In a recent sewing machine controller put on the market there is inserted in the circuit a coil of wire with about 120 turns of such high resistance as to block the circuit completely. This coil is placed inside a neat metal treadle-box, with a slightly curved strip of phosphor bronze above it and just under the treadle. The coil is well insulated by a special cement, except directly beneath this strip. As the operator presses her foot upon the treadle, the strip of phosphor bronze is pushed down upon the resistance coil. On account of its curved contour, it does not, under a moderate pressure, come in contact with all the coils. Those with which it does make contact, however, are short circuited, thus reducing the resistance of the entire unit and permitting the passage of some current. The harder the operator presses upon the treadle, the more the strip is flattened out and brought into contact with the coil. The more of the coil is short-circuited, the more current is allowed to pass.



Detail View of Foot-controlled Motor Rheostat which Operates Sparklessly.

With increased current, the motor, and with it the machine, runs faster. Therefore the operator has, theoretically, 120 different speeds at her disposal and the harder the foot pressure is the faster the machine will run.

NEW ELECTRICAL METHOD OF CLEANING SILVER—A HELP TO MOTHER.

Most of us have seen our women folk endeavoring to scour or polish silverware, particularly the discolored knives and forks,

Cleaning Silverware Is no Longer a Detestable and Aggravating Task, Thanks to the Electrical Method of Cleaning it Here Described.

by any one of several well-known first-hand methods involving the use of ashes, pastes or compounds variously guaranteed to shine anything, even down to lead. And most of us know what an unpleasant and thankless task this is to everyone whose lot it is to perform it.

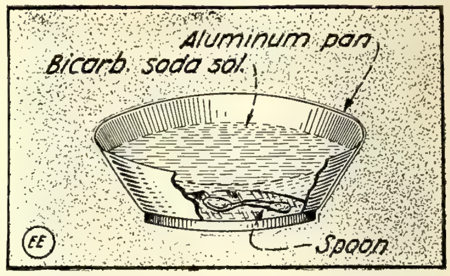
Instead of scouring the knives and forks and taking the chance of marring the finish of the silverware, there is now an electrolytic method of quickly and efficiently cleaning such silverware, no matter how soiled or discolored it may be.

The illustration herewith shows the simple "apparatus" required to carry out this process. It is necessary to purchase a small aluminum pan about eight or ten inches in diameter, which may be of any shape. Be sure that the vessel is of aluminum. A sufficient quantity of bi-carbonate of soda, costing less than ten cents a pound, is then placed in the pan with boiling water to give a saturated solution. This is placed on the kitchen stove, so as to be kept thoroughly hot while the discolored silverware is immersed in the solution and allowed to rest on the bottom of the pan. It should be noted that the various silver pieces must not touch each other, but they must invariably touch the aluminum vessel.

An electrolytic action is set up so that current passes between the aluminum container and the silver pieces, and the latter, being positive to the aluminum, causes in consequence an extremely slight amount of the silver to be disintegrated from the ware. This of course results in the incrustation being removed also, and when the process is finished and the solution emptied out of the pan, there will be found a blackish deposit adhering to the sides and bottom of the aluminum vessel. This represents silver oxide and other matter which has been electrolytically removed from the silverware, leaving the latter in a practically new condition.

Contrary to general opinion, this process is not injurious to the silverware. The amount of silver disintegrated or deposited in the bath is so very slight that it amounts to almost nothing.

A recent report made to the American Chemical Society on this electrolytic method of cleaning silver by contact with aluminum in an alkaline solution, mentions among other things: that a number of careful tests proved that sodium carbonate was slightly more efficient than the sodium bicarbonate. The best concentration for the solution was found to be that calling for one teaspoonful of washing soda and one teaspoonful of table salt to each quart of water. Best results were obtained in these



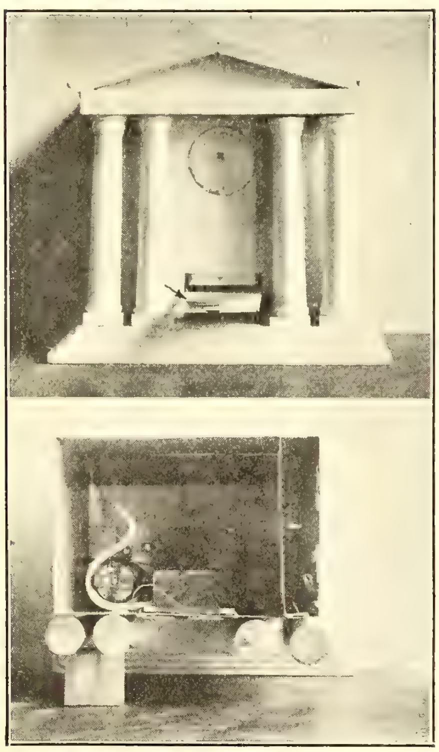
To Clean Even the Dirtiest Silverware, Procure an Aluminum Pan and Mix up a Strong Solution of Bicarbonate of Soda. Keep it Boiling and After the Spoons, etc., Have Laid on the Pan Bottom for a Few Minutes, They will be Found to be Thoroly Clean.

tests when the cleansing solution was maintained at the boiling temperature during the process, and aluminum proved more efficient than zinc for use as the active metal in contact with the silver.

Principally, this method results in a distinct saving in labor, and it is, besides, very convenient and clean. To quote the report in question: "It removes the tarnish from both the sterling and plated silverware without appreciable loss to the metal."

WHISTLE, AND THIS ELECTRIC TOY BANK GRABS YOUR COIN.

A very interesting electric toy bank has been recently invented by Christian Berger, the well-known inventor of the submarine wireless apparatus and of the various elec-



Whistle but Once and This Electric Bank Hustles Your Coin into the Vault.

tric toys which appeared some time ago in this journal.

The bank as it appears when finished is illustrated in figure. The mechanical and electrical details are apparent from lower figure. The novelty of this toy lies in the that that the coin which is to be deposited in the bank is placed upon a horizontal platform, and by the aid of a whistling sound it is automatically deposited. This is done by means of an electro-magnet acting upon the platform which is controlled by a special microphone, connected with a battery.

Referring to the second figure, it will be noted that the battery is held in a suitable receptacle as shown on the left. The coin door is in the foreground center and can be seen by referring to Fig. 1 (at the top) showing the circular opening. The microphone is located in the right compartment and consists of a fine wire pivoted on an insulating rod. The end of the wire bears lightly upon a piece of gold foil fastened to the side of the safe, which latter is made of thin sheet metal. The electro-magnet used for retaining the coin platform horizontally is located at the bottom. The connections are made the same as for the *Electric Dog,* described in our June issue.

The operation of the toy is as follows: The money which is to be deposited is placed upon the platform, Fig 1, which is pulled down until the electro-magnet holds it and keeps it in a horizontal position. By producing a sound such as clapping one's hands or whistling, so as to actuate the sensitive microphone, the coin platform is released instantly and deposits the money through the upper hole, Fig. 1.

The safe is fitted with a door and lock at the back for the purpose of removing the money collected therein.

AN ELECTRIC MOTOR HORN WITH TRIMMINGS.

Henry Sieben, past wharfmaster and past master of plain and fancy inventing, has added another to his list of momentous contraptions; this is the way his local newspaper writes him up, at any rate. His latest claim to the title of champion heavyweight patentee of the United States is a combination electric motor horn and signaling device for the front and rear of a motor car.

The device consists of a handsome figure—the inventor says he will make it to suit any taste, from Venus to Charlie Chaplin—and a horn of unlimited possibilities. The horn possesses remarkable noise-producing qualities—enough to wake the dead, avers the sponsor of the magnificent looking specimen of manhood here portrayed.

When the driver presses the button the

At Left: New Shrieking Auto Radiator Decoration. At Right: Direction Indicator and Tail Lamp; Both Electrically Operated.

figure's arm goes up in a menacing manner, the mouth opens wide and wild shrieks issue forth. For the rear of the car Mr. Sieben has added a direction indicator and tail lamp to his device.

Should the driver desire to turn to the left, the arm of the figure in the rear will point in that direction. At the same time the mouth will open and the same wild shrieks emanate. On the figure's chest there reposes the tail light.

PICTURING ELECTRIC SERVICE TO AMERICA'S MILLIONS.

IMAGINE nearly 800 posters, all in colors, all by individual artists, and you have an idea of the task before the judges who recently selected the prize winners in the America's Electrical Week poster competition conducted by The Society for Electrical Development. The competition closed June first. Over 800 posters were received representing over $100,000 worth of designs.

Since America's Electrical Week appeals alike to rich and poor, man and woman, merchant and customer, artist and engineer, everybody was asked to suggest a fitting design to drive home into every hamlet and city in the land, the message—"Do It Electrically!"

The judges were unanimous in their choice—which is shown here. In colors it, of course, is many times more effective.

The judges are recognized as representative commercial art critics.

The poster might well be entitled "Aladdin; Symbol of Service."

Of all the Arabian Nights Tales, the story of Aladdin is, perhaps, the most fascinating. The all-powerful slave, who could be summoned by the mere rubbing of a mysterious lamp; the treasures thus at the command of the lamp's owner; these make a narrative which will live as long as the world lives. Yet the modern Aladdin, pictured in this poster, performs wonders that make the adventures of our Arabian Nights hero pale into insignificance.

Gone is the ancient lamp. Now it is the gentle touch of a button and forthwith comes the Genie, *Electricity*. He bears, not precious stones, but things far more precious—Light, Heat, Power. It is the power that makes the world go 'round, the heat that forever drives out cold, the light that turns night into day.

And this wonderful Genie comes and goes, as did Aladdin's, at our bidding. He is always "at your service." How better could the thought of America's Electrical Week, "Do It Electrically" be presented to the people?

This design will be used throughout the campaign, millions of poster stamps, window and car cards, lithographs, bill posters, in newspapers, magazines, etc. It will be reproduced at least 200,000,000 times.

America's Electrical Week Poster. Winner of Grand Prize of $1000 in Nation-Wide Electrical Poster Competition. Over 800 Leading Artists Submitted Designs. This Design Will be Reproduced 200,000,000 Times During the Big Campaign This Fall.

The posters were assembled for the inspection of the judges on June tenth in the Anderson Galleries, Forty-first Street and Madison Avenue, New York City. In accordance with the rules of the contest, the Poster Committee appointed by the America's Electrical Week Executive Committee, then turned over to the judges the entire collection of posters.

The judges were further instructed to select those posters which should be classified as eligible for the public vote to decide the winner of a special $300 Public Choice Prize.

In this way the Society for Electrical Development relieved itself entirely from the judgment of the posters and placed all the responsibilities in the selection of the prizes upon this Jury of Awards. The Society exercised no influence upon the determination of the prizes and left the decision of the awards exclusively to the judges.

After many deliberations, the judges eliminated all posters not entitled to be considered for the Public's Choice Prize. Some 125 posters survived this test. The judges then determined the winners of all of the prizes except the Public Choice Prize.

The prize winners were then voted on with the following result:

No. 717—the first prize of $1,000—Harold von Schmidt, San Francisco, Cal.

No. 174—the second prize of $500—John A. Bazant, Bronx, N.Y.

No. 452—the Art Students prize of $200—Edward Staloff, Jersey City, N.J.

No. 392—the first school prize of $100—Harold H. Kolb, Somerville, Mass.

No. 80—the second school prize of $50—Wm. E. McKee, Jr., Hollywood, Cal.

No. 84—the third school prize of $25—Armand Moreda, Brooklyn, N.Y.

No. 576—the fourth school prize of $15—Ruth M. Jameson, Buffalo, N.Y.

No. 720—the fifth school prize of $10—Edna E. Crowley, Chicago, Ill.

This decision made No. 717, entered by Harold von Schmidt of San Francisco, the official design for America's Electrical Week. It is interesting to note that this design, although not the winner of the Public Choice Prize, figured prominently in the public voting wherever exhibited; this fact confirms the judgment of the jurors that poster No. 717 carried a strong appeal to the public, and that the message of electric service at the push of a button set forth in the design "gets across."

LEAD LINED CABINETS REDUCE X-RAY BURNS.

In the illustrations shown herewith we see one of the latest French X-Ray examination cabinets which are used in the manner shown, the patient standing behind the cabinet and the fluoroscopic image being cast upon either of two rising and falling screens.

The X-Ray tube of large size, measuring about 12 inches in diameter and provided with water cooling attachments to carry off the heat from the heavy current used, is supported behind the patient so as to throw the X-Rays through his body onto the fluoroscope screen mounted in front of the cabinet. At the left of the picture may be seen part of the X-Ray stand and holder with regulating apparatus on it for timing the length of the radiographic exposure. This timing of the exposure is accomplished by means of a special clockwork mechanism.

Photo from Jacques Boyer

French Physician Examining Entire Chest of Patient with High Power X-Ray Set. Insert View Shows X-Ray Skin Growths at X, Resultant from Over-Exposure to These Powerful Rays.

Naturally the exposure to the X-Rays must not be too long or else the patient is liable to have his skin burned. In the case of special investigations and where considerable research work is carried on in this direction there is a danger of contracting a serious growth caused by the X-Rays and a specimen of which is shown in the lower right-hand corner of the illustration—the growth somewhat resembles a wart, appearing in this case on the fingers of the hand and the principal ones marked by crosses.

The cabinet which encloses the patient as shown herewith is therefore lead lined, lead having been found to be a very good screen or shield for the X-Rays. The particular outfit here shown is of French design and there are also provided special rubber gloves impregnated with lead salts, which help to protect the surgeon and physician to a still greater extent.

The Sperry 1,280,000,000 C.P. Searchlight Throws Beam Over Fifty Miles

PEOPLE residing within fifty miles of New York City have been surprised to see an extremely powerful searchlight ray sweeping over the sky at night during the Fall months. This penetrating flash of light had its origin in Brooklyn, N.Y., where Mr. Elmer A. Sperry, the gyroscope specialist, and his engineers, have been testing out the merits of his new electric projector. It is said to be the most powerful in the world, its scintillating rays having been seen over 50 miles away. The searchlight shown in the photograph, Fig. 1, is nine feet high, while its accurately polished reflector measures five feet in diameter, and it produces a candle power of 1,280,000,000, which is *some* light.

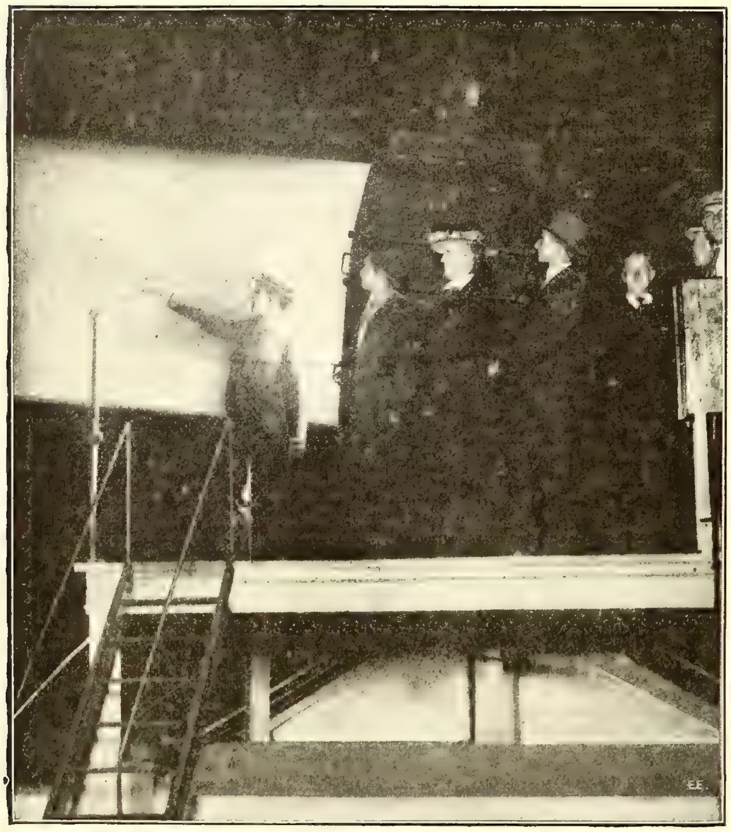


Photo Copyright by Underwood & Underwood.

Fig. 1. This Powerful Electric Searchlight Throws a 1,280,000,000 C.P. Beam of Light Which May Be Clearly Seen Over 50 Miles Away.

Up to the present the source of light which has been universally used has been the positive crater of a pure carbon arc. This pure carbon crater has a fairly constant brilliancy of approximately 150 candlepower per square millimeter, and it has been considered that this was the highest attainable brilliancy. It is true that the old standard searchlight arc gives the highest brilliancy obtainable from a heat radiating solid, since carbon has the highest melting point of any known element, but this brilliancy has been surpassed in the Sperry arc by making use, in addition to this heated crater surface, of a superheated vapor or gas produced in the arc, says Captain Adelno Gibson, of the U.S. Coast Artillery Corps in the *Aerial Age Weekly*. This superheated gas is formed from certain special materials that are powerful light producers and with which the positive carbon is impregnated.

For the successful use of this bright vapor as a searchlight source, it is necessary that it be concentrated in a very small area. This is accomplished in the Sperry arc by maintaining a very deep crater in the positive carbon and into which crater this bright vapor is kept pressed. This vapor causes the mouth of the crater to emit a very intense illumination running, for example, as high as 500 candlepower per square millimeter, or 320,000 candlepower per square inch. The force used to keep the vapor pressed back into the crater of the positive is the arc flame from the negative carbon and is similar to the arc flame used in the old standard searchlight lamps. The arc flame appears as a flame of considerable velocity emanating from the negative carbon, and gives but very little light in either the old or Sperry type of arc as compared with the positive crater.

The following tabulation of the specific brilliancies in candlepower per square millimeter, and which is rightly taken as the basis of efficiency-comparison for all arc work, shows this tremendous light intensity of the new Sperry arc:

Ordinary Tungsten filament..	2.4 to 5.4
Ordinary Tungsten filament, nitrogen filled	10.0 to 20.0
Tungsten at the melting point, (3500° C.)	72.0
Arc flame, ordinary white flame arc	7.0 to 20.0
Surface of crater "spot," flame arc positive........	50.0 to 90.0
Crater surface pure carbon average	150.0
The Sperry arc being the candlepower of dense positive vapor in deep crater of a two-flame arc, special projector electrode	500.0
Sun at 30° elevation.........	775.0

Another distinct advantage which the new arc has over the older form lies in the very great reduction in area of the light giving source or crater. It is possible by using this new type of arc to concentrate the vapor into a crater which has a very much smaller mouth area than heretofore possible with a pure carbon arc of similar amperage. A distinctive advantage results from this reduction in area of crater, in that the angle of spread of the searchlight beam itself is materially reduced and the beam made much more nearly parallel throughout its length. For the standard 150 ampere arc, the diameter of the positive carbon is only 5/8 inch and that of the crater diameter somewhat less. The diameter of the negative carbon is only 7/16 inch and with its smaller holder casts a very much smaller shadow on the center of the mirror, thus, also, adding more reflected light to the beam.

The principle upon which satisfactory operation of this high intensity arc depends now shows itself to be entirely different than previously supposed. It was first believed that current density was the principal factor for the operation of such arcs, but we have found out experimentally by current densities ranging from 100 to 1000 amperes per square millimeter that current density is not the controlling factor, but that current value is the important factor.

It is evident that to obtain this highly concentrated light source and at the same time produce constantly a sufficient supply of bright vapor to fill the positive crater, a rapid consumption of the positive electrode is necessary. It is for this reason that the positive carbons are so much longer than those previously used, being 44 inches for the standard 150 ampere arc. In the old type searchlight arc rapid consumption of the positive was not necessary since the gaseous products were not used at all in the production of light, but in the Sperry type of arc this rapid burning of the positive is necessary to provide the light emitting gaseous materials.

The Sperry interests after two years experimentation with this new form of arc, are now manufacturing projector searchlights giving a candlepower intensity at the arc for a 36-inch size, which, aside from the accompanying reduction in the divergence of the beam gives an illumination on the target of six times that formerly obtained with the older type searchlight of similar diameter.

An elevation of the Sperry searchlight is shown at Fig. 2. The control box contains a shunt wound motor (right) direct connected to both a centrifugal blower and a gear train for the feeding and rotating mechanism. The blower furnishes air through two passages to the positive and negative carbon holders respectively. The air supplied to the positive holder is forced between a number of heat radiating discs which surround the end of the holder nearest the arc. The cap is open on the upper side to allow the air to escape from the positive holder. This method cools the positive carbon and also removes the heat from the mechanism of the positive carbon holder, received mostly by direct radiation from the arc.

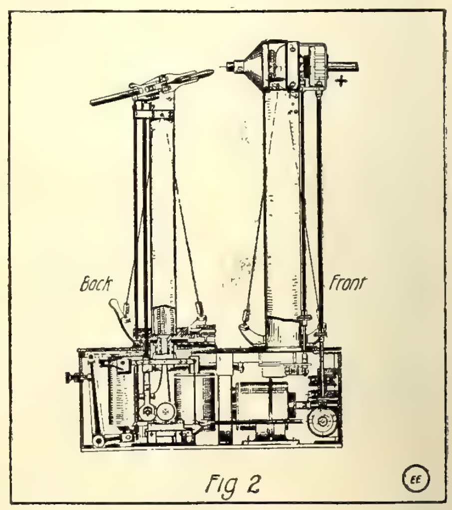


Fig. 2. Electrical Operating Mechanism of New Sperry Billion Candle-Power Searchlight.

The positive carbon is rotated, being connected to the shunt motor through a vertical shaft and a worm gear. A small

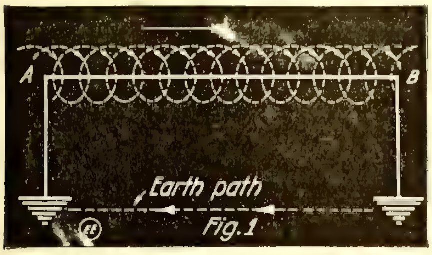
(Continued on page 524)

The Marvels of Modern Physics

By Rogers D. Rusk, B. Sc.

THE WIRELESS ERA.

THE Wireless Era is a name frequently given to the scientific period upon which we are now entering, by people who realize only vaguely themselves what they actually mean by it. In reality there



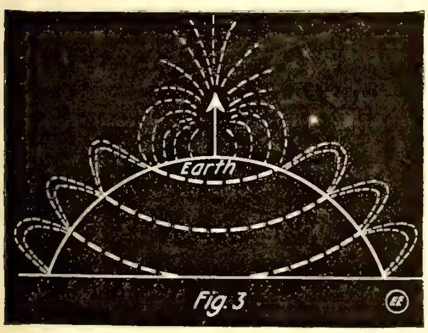
Illustrating How a Current of Electrical Energy Is Transmitted by Ether Whirls to a Point by a Conductor.

is a surprising relation between *wire* and *wireless* transmission. That they are not distinctly different phenomena may put new meaning in the phrase, "Wireless Era."

The question has often been asked "Will all wires be done away with in the future?" Now the theory most generally accepted at present is that the energy of an electric current in ordinary wire transmission does not reside *in* the wire, but in the ether surrounding the wire, and that the wire is, as its name implies, merely a conductor to conduct or lead the current here or there. To make this clear, let us imagine a current moving in the wire in Fig. 1, from A to B and returning by the ground. The dotted spiral lines represent the strain in the ether due to the electro-static and the electro-magnetic lines of force about the wire. The important point to notice is that the current, without this field, would be lifeless and inert because the magnetic field represents the energy of motion of the current; it would then have no energy of motion, for the energy is really stored up in the ether and is transmitted by it.

Let us look beneath the surface a moment at wireless transmission. In Fig. 2, the wireless waves are represented as traveling from aerial A to B. We cannot doubt for a moment but what the energy is transmitted by the ether, as no conducting medium is present. Therefore, the main difference between *wire* and *wireless* transmission seems to be that while in *wire* transmission the energy is directed to a definite point, in *wireless* it spreads out and dissipates itself in all directions.

A further study of Figs. 1 and 2 may reveal the reason for this. In a steady direct current the field is steady and continuous. Change this current, however, to an alternating one and the field or ether strain



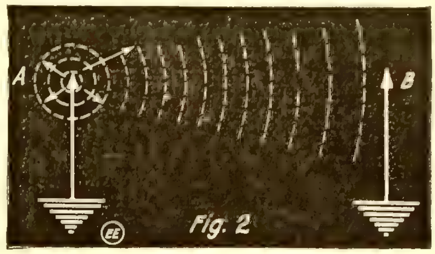
This Diagram Gives a General Idea as to How a Radio Station Throws Off "Ether-Ripples" of Radiant Energy, the Same as When You Throw a Stone into a Still Pond.

varies accordingly, producing an undulatory motion of the ether. That is, the field about the wire rises and falls periodically. With an ordinary alternating current the strain in the ether is most noticeable just about the wire and becomes negligible a short distance away, although theoretically the waves may travel at each reversal a long distance before being dissipated. Let us raise the potential and frequency, however, and see what happens. The field rises to full strength in a very short time, and the waves follow each other at a greater speed. This means that radiation is going to amount to much more than before. The waves are going to be stronger, and their number will be multiplied many times. If instead of using a wire to direct the energy from A to B, we shorten the circuit very much, making it merely a local circuit at A, and if we put another small or local circuit at B, then some of the radiant energy from A will be intercepted at B, and these waves passing B will induce a slight current at B. *This* is wireless transmission. See what a gradual step it is instead of a very sudden one from wire to wireless transmission. In one case we have a small radiation factor, due to a real current in a conductor. In the other case we have a high radiation factor due to the absence of a long conductor. In the first the energy is directed; while in the second, it spreads out in all directions. The medium of transmission of the energy is the same in either case. The result is that in one case a large per cent of the energy reaches its destination, while in the other case only a very small per cent does.

The field about a wire carrying a direct current acts quite like an invisible whirlpool which pulls the electrons, or charged particles in the wire, along. The field, in turn, grows with the current, for the action is an inter-dependent one, and the result is a continuous current. If, with an alternating current, the oscillation frequency is high, the current does not have time between reversals to penetrate the wire deeply, and it is found that the current exists only on the surface of the wire. This is the well known *skin effect* and shows again that the energy must reside in the external field, and that it takes some appreciable time to start the electrons in motion. This is what we call a current *in a wire*.

Wireless telegraphy came into prominence in 1896, when Dr. Guglielmo Marconi first demonstrated its commercial value. Since then its importance has increased by leaps and bounds. The submarine has been directed from the shore by wireless; the human voice has been transmitted hundreds and thousands of miles; and various kinds of mechanism have been controlled by it. However, the glaring predictions of a wireless era for a while somewhat unduly inflamed the imagination of the public. Let us look at the facts.

It is very significant that one prediction of a few years ago has not been realized, and that was concerning the wireless transmission of power. *Power* and *energy* are



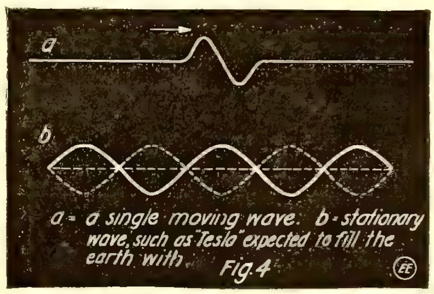
Representing the Detection, at a Point "B," of Radiant Electric Energy.

two different things. Energy is any capacity for doing work, while power is the rate at which work is done. Now sufficient energy may be sent across the ocean to easily operate a delicate detector, but the rate at which any work is done is ridiculously minute. Energy has been transmitted but the power was negligible. When a submarine is controlled at a distance, it is not power from the shore which operates the machinery, but rather *power* from some source on board the boat itself which is controlled by the *energy* transmitted from the shore. The strength of the waves decrease too rapidly with the distance to allow of any great amount of energy being transmitted. Most everyone remembers the rule that the intensity of light varies inversely as the square of the distance from the source. Applying this to wireless, and neglecting other losses, at the distance of one mile the energy would only be

$$\frac{1}{25,000,000}$$

of its original value. This in itself would stamp the wireless transmission of power as impracticable unless a different method of transmission than that now in use were discovered.

Nikola Tesla believed he had solved the problem and in 1905 took out patents for a system of wireless transmission of power, with the ether as the medium. In brief, by his system, he intended setting up powerful, stationary, electric waves, setting the whole earth in vibration due to the reflection and superimposition of waves from all parts of the earth. The principle is similar to that of a string tied at one end and waved back and forth by the hand at the other. Waves from the hand would travel to the opposite end and be reflected back



If we Tie a String at one End and Oscillate its Free End Back and Forth, There Will Be "Stationary" Waves Set up Along it as at B. Tesla Expected to Vibrate the Earth with such Waves.

(see Fig. 4) creating nodes and loops of vibration in the string. The proposition, it was claimed, had been partially demonstra-

(*Continued on page 538*)

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

How the Martian Canals are Built

BEING the chief chronicler of a world-famous man is never an easy task. Famous men, as a rule, are most difficult of approach, as they have a mean trick of keeping aloof of the ordinary garden variety of humans. Not that they do not wish to have themselves chronicled in due and accepted manner, no, quite the contrary. They do. And they crave for publicity, more so than a stub-nosed society débutante, but they want the public to believe that they are far above such material things. They wish you to think that they are as modest as a spring violet, but down in their innermost innermostness, they like it if you climb to the top of a skyscraper proclaiming their greatness. Of course, they can't do it themselves, but they like to have it done for them, by some fool chronicler. This induces them to think that they are real modest, but I have found out long ago that modesty, like so many another vice is a business, a pretty little business at that, carefully studied and carefully plied to fool the public at large.

Now to chronicle the usual species of great man—see first paragraph, line one—is far from simple, even if you know the trick of chronicling. A simple recipe on the subject, therefore, might not be amiss. Proceed as follows:

Obtain a first-class introduction to the G. M. Next mix a fair amount of tact with a little of the G.M.'s accomplishments and his work. Mix with a generous quantity of soft salve and carefully cover the G.M. with same. The thicker you lay it on the better the result. Do not fail to tell him several hundred times that the public is starving for a message from him.

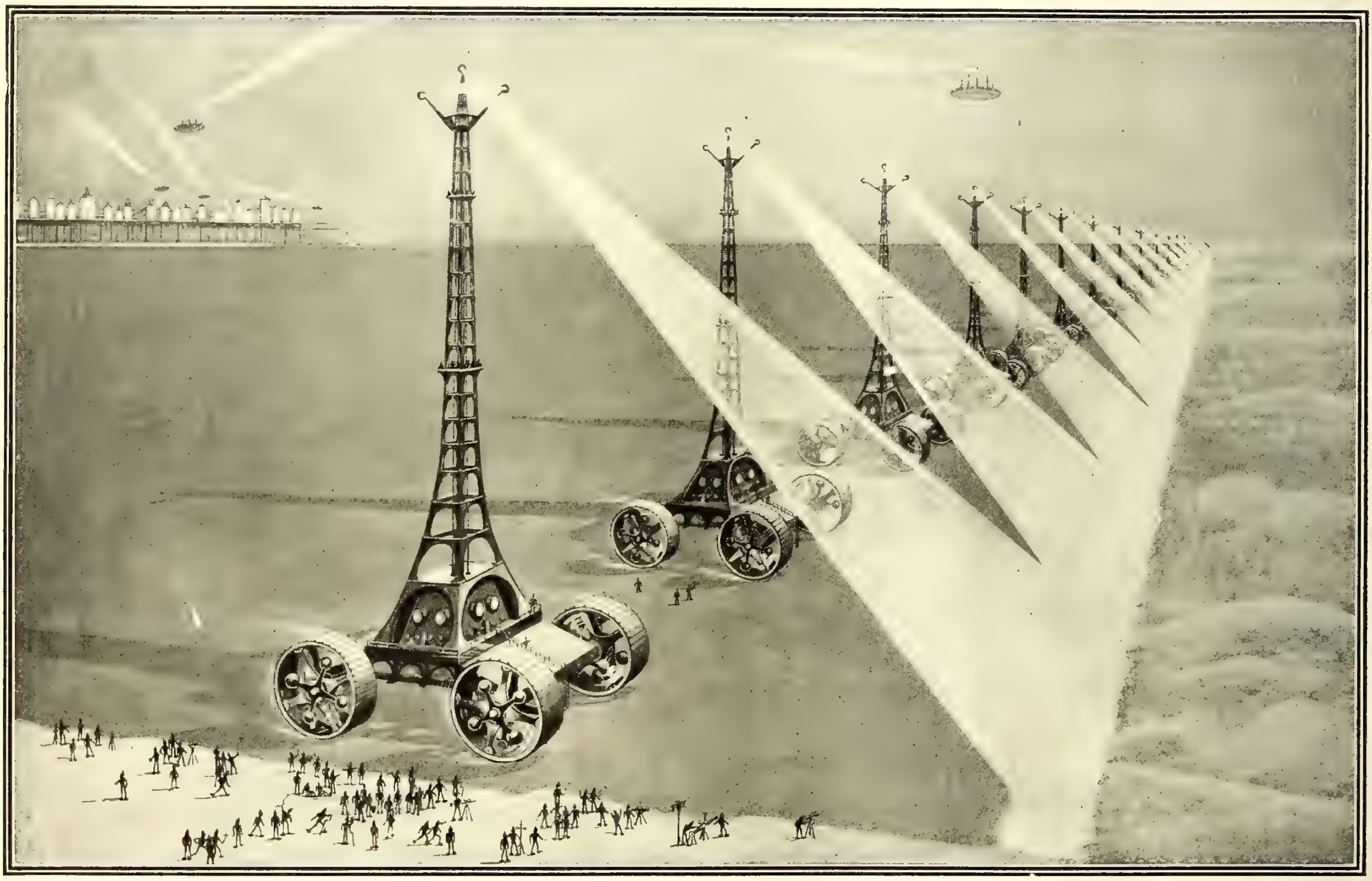
Once prepared in this manner, he will, as a rule, start to gush, hesitatingly at first. Apply more salve plentifully, rubbing it with the grain, *never* against it. As a rule the G.M. will now talk freely. All that is then necessary is to pull out your notebook and take down the precipitate as quickly as he talks. Embellish with scraps of your own imagination and the chronicle-compound is ready to be sold to the highest bidding magazine Editor-Gazink-in-Chief.

Which brings us down to earth, or rather away from it. For, if your great man is Baron Münchhausen and if the said Baron has taken it into his head to make the Planet Mars his abode, how can you chronicle him if he don't want to be chronicled, or rather can't?

What good is it that Baron Münchhausen has appointed me as his chief and uppermost chronicler, if the Planet Mars persists in rushing on through space, getting further away from the earth every day? Of course, I can't blame the Baron in the least, for he probably did his best to get his wireless messages down to me, but just consider for a moment what he is up against.

When I first began to take down my nightly reports from Münchhausen, the Planet Mars was near opposition to the earth. It was then about sixty-five million miles away from us. Gradually the distance was cut down to sixty million miles and his radio messages easily bridged this distance, enormous as it was. As will be recalled, the radio-telephone messages were recorded on the Baron's *Radiotomatic* plant, on the moon, erected there by him. This was done because the moon has practically no atmosphere to interfere with the weak impulses, after they traveled across the sixty odd million intervening miles. Recorded on the Radiotomatic plant, the messages were in turn amplified several thousand times and thence relayed across the comparatively short distance of 238,000 miles, separating the moon from the earth.

Thus every night I took down the Baron's messages and everything ran along like clock-work for many days. Münchhausen, of course, knew exactly whether the messages reached me or not, as he could readily check them. The Radiotomatic plant on the moon, as will be remembered, recorded the message, but did not send out the amplified message itself till several hours later, being thus regulated by clockwork. The impulses never were sent out till 11 p.m., Eastern terrestrial time. Thus the Baron, who, of course, had a very fine radio plant of his own on Mars, could hear his own message, as well as I could. For, if the radio waves were powerful enough to travel from Mars to the moon, they, of course, could travel from the moon to Mars, because the sending plant on the moon was even more powerful than the first one which Münchhausen had on Mars. It is just like an echo. If the voice



" . . . This ray which has the property of disintegrating the ground by breaking up the atoms of the desert sands, has immense inherent powers. The ground, rocks, sands, etc., everything "melts" before it, as snow goes up in steam before an oxyhydrogen flame. . . ."

is strong enough to carry from you to the distant echoing wall, it will travel back just as readily, and you can hear your own voice. Thus the Baron heard his own message every day, just as well as I could.

But there came a time when the planet Mars, which travels in a vastly wider orbit than our earth, became outdistanced by the latter. Every day the two planets became separated further and further till finally Baron Münchhausen's Radio messages could no longer bridge the gap. It must be remembered here that the Baron made his trip in the *Interstellar* at the time of opposition of the two planets, i.e., when the two were but sixty million miles separated from each other. But when the last message reached me, Mars and the earth were already over seventy millions miles apart—almost twice as far distant from each other as when I took down the first message.

For days and weeks I waited nightly for the usual 11 p.m. message but not a sound came from my Radio Plant. I installed hyper-sensitive detectors, which became so sensitive that I could hear the waves sent out by a Ford Magneto at Melbourne, Australia! But all to no avail.

Of course, I knew that sooner or later the Baron would erect a higher powered sending machine on Mars, but it took him some months before he finished it.

In the meantime I was a chronicler without having anything to chronicle and everyone poked fun at me, as was usual when something went wrong with my plant.

Also, as was their habit, the Yankton papers began to lambast me in their usual style. The editors, it seems, had made it a point, before taking on reporters, to first try them out on me, and thus many rare and beauteous literary flowers bloomed in our local press. This is a fair sample taken from the Yankton *Trench Raider*:

PSEUDO SCIENTIST LOSES ETHERICAL WAVE-CONNECTION

Claims Earth and Mars Estranged. Are Suing for Separation!

Wuxtra! Wuxtra!! Lost! Wireless Waves between Earth and Mars.

Anyone finding stray wireless waves from Mars should promptly return same to 197 Mifflins Manor Road. Fabulous Reward. No answers questioned!

Perhaps, gentle readers, you won't believe it, but our self-appointed chronicler of the wondrous imagination, the Honorable I. M. Alier, the illustrous citizen of this Burg, lost his connection with that dear old friend of his, the venerable Baron von Münchenstiner. Our star reporter, who called on Honorable I. M. Alier yesterday to ascertain why the dear Baron, has of late been so extraordinarily quiet, was informed that the earth and Mars were on the "outs" again. You wouldn't suspect it of such an old married couple, but I. M. Alier informs us that every time the fossilized pair get together—opposition he called it—right away, instanter, they begin to oppose each other. She goes this way, he goes that. Shocking! And they won't "make up" till 1918. Isn't it scandalous?

At any rate, I. M. Alier says Münchenheimer is now seventy million miles away from us, whereas a few months ago he was only fifty million miles away. And he furthermore proclaims to all of humanity, and others, that Münchenhauser's wireless waves are no longer pow'ful enough to bridge the extra distance. Such are the fickle wavelets. Won't stretch a point; just like the installment house when the 269th payment is over due.

Our reporter suggested to Honorable I. M. Alier that perhaps the waves could be pieced together endwise and thus make them reach, but he received the suggestion coldly and without enthusiasm. The Honorable I. M. Alier seems to mourn greatly over the lost wavelets and the interrupted connection. But what would you do?

Cheer up, Honorable I. M. Alier. What's thirty or forty million miles and a few billion etheric waves between friends? Just think, the Baron might be on the Planet Neptune. And that old boy is 2,654,000,000 miles away! Just think of it!

Well, here's hoping that the Baron will soon find out a new brand of waves, to shoot at us. And let's hope that they are of the cold variety. Hot (air) waves have a short periodicity!

THE majority of our scientists today are in accord with Lowell's theory of the Martian Canals. That these canals exist, no one denies any longer. That they are artificial and that they carry waters to keep a thirsting planet from perishing seems pretty well established.

But how such immense waterways, 3,000 miles long and 25 miles wide, could be constructed has been one of the greatest puzzles to science.

In this instalment is advanced a new and fantastic theory on the subject. Will it seem so extravagant one hundred years from now?

DON'T MISS THE DECEMBER NUMBER OF THE "E. E."

The December issue of THE ELECTRICAL EXPERIMENTER will fairly teem with good things. A number of new authors will contribute to this Yuletide issue, which the editors are striving hard to make the very best one yet published.

There will be a special Xmas feature article, the latest news of the scientists, recent happenings in the realm of wireless, and all the usual departments. No matter whether you read THE ELECTRICAL EXPERIMENTER from the viewpoint of a layman or a scientist, you will surely find a full 15 cents' worth in the December number.

"Electric Submarine Camera." By H. Hartman, C.E.

"Baron Münchhausen" in another exciting adventure. By Hugo Gernsback.

A "Xmas" story thoroly seasoned with volts, ohms and amperes and a dash of "construction details" to tickle the Bugs' literary palate.

"The Marconi $1,000,000 Wireless Suit Against the United States Government." By A. Press, B.Sc.

"Reminiscences of an Electrical Trouble-Shooter." By H. de Scott.

"The How and Why of Radio Apparatus." Part Two.

"Announcement of the Results of the $25.00 Interrupter Prize Contest."

"Another Handsome Supplement Photo of a Well-known Radio Scientist"

"How to Build An Electrical Thermometer." By Samuel Cohen.

"The Measurement of Capacity."

Also there will appear the promised article on "The Revolving Mirror for Determining Spark Characteristics."

"Experimental Chemistry Course." By Albert Wilsdon.

"Marvels of Modern Physics." By ogers D. Rusk, B.Sc.

But everything comes to an end sooner or later. So one evening after I had resigned myself to the idea that I would not hear from Münchhausen, again till the 1918 opposition, I was suddenly electrified by an unfamiliar shrill, high-pitched note, coming in through my head receivers. The clock had just begun striking the eleventh hour, and I immediately knew that it must be the Baron.

The whistling note continued for almost ten seconds, running higher and higher till it finally went above audibility. Almost instantly the familiar sepulchral but sympathetic voice of Baron Münchhausen broke in my ears and I was overjoyed to hear him talk once more!

"Well, at last! How are you my dear Alier? Exhausted from waiting for my message that never came? I can readily sympathize with you, my dear boy, but you can imagine that it could not have been helped. Bridging seventy million miles by radio waves is no cinch, as you Americans are fond of saying. You will believe me when I tell you that my new Wireless Plant is a pretty little affair. It takes but a trifle of 300,000 kilowatts to operate it. A mere 400,000 horsepower! But you can rest assured that I will maintain communication with you even when Mars is in conjunction, that is, when the earth and Mars will be at their furthest separation, which is 230 million miles. That is the reason of the enormous energy. Of course, I am not using the entire 300,000 kilowatts as yet, but I will need the full energy when the two planets will be at their furthest separation. Professor Flitternix figured it all out, and he thinks too that we will be able to maintain communication when the sun comes between Mars and the earth. It is a task to send waves almost around and past the sun, which ionizes the ether for millions of miles around it, but we have fond hopes of maintaining an uninterrupted interplanetarian radio service in spite of the handicap.

But I am certain that my new radio plant, with its many unique innovations, does not interest you half as much as our doings on Mars. And, as the recorder on the moon does not hold long and extended messages, I must of necessity be short.

In my last message I spoke about Martian amusements and our visit to a Martian "showhouse." I will now try to explain to you how these wonderful people build their stupendous canals. I have already told you how the waters are moved in these canals on Mars, due to the indirect agency of the sun. I am happy in now being able to tell you from personal experience how these ponderous engineering feats are undertaken.

You are, of course, well acquainted with the fact how incredulous your scientists

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When Amateur Wireless Was Young

By H. de Scott

IT is a far cry from the modern wireless set rated at several hundred kilowatts and capable of hurtling forth its etheric waves over several thousand miles of space, to the small spark coil excited from a battery, with which Marconi and practically all other early radio experimenters worked.

Looking backward a few years the writer well remembers the early reports of Marconi's great successes in transmitting the now immortal 3 dots—representing the Morse code letter "S"—across the broad Atlantic from Cornwall, England, to Nova Scotia, Canada.

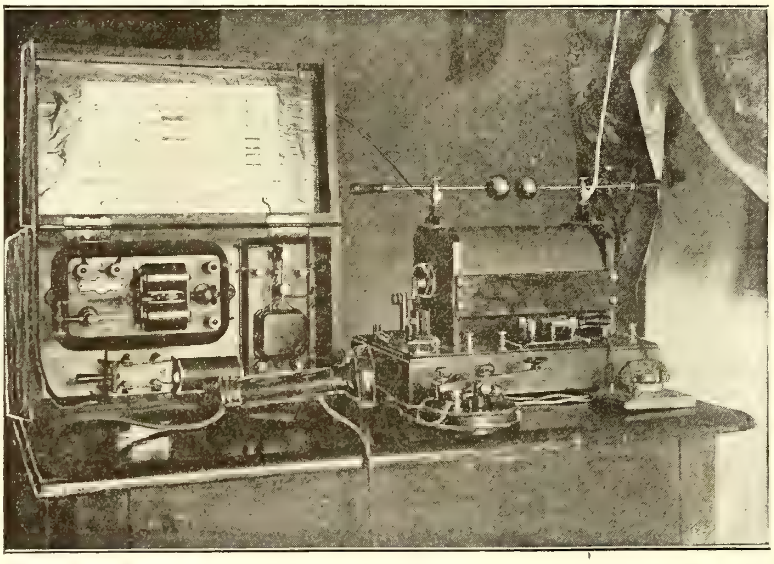
Interest in wireless matters ran high in those palmy days, when the amateur's aerial on the roof tops of lofty buildings was a rare sight indeed. But, so far as *electrical* experimenters went (we had no *radio* experimenters in those days), their interest might run high or at any old speed they liked, but one thing was certain: precious little information was available in book or magazine form for some years to come.

Around the year 1900 and in the next few years after that time, the author was residing at Trenton, New Jersey, and carried out a number of careful experiments on the old coherer type radio receiving sets. The first bit of information that he remembers reading was that endeavoring to explain how to construct a crude form of coherer. The patent specifications fairly teemed, of course, with very elaborate specifications on the construction of the improved Marconi type coherer, which was a very beautiful instrument, to be sure. But, in view of the fact that no air pumps were available and also as there was considerable doubt as to the size of the silver and nickel filings to be used in it and their quantity, little progress could be made with this data, at least at the outset.

However, a hand-book which appeared about this time, contained the quite startling information that if we were to take two round carbon, motor brushes, and insert them end to end in a glass (boiler gauge) tube, and provided, however, that we had a small quantity of clean, soft, iron filings between the plugs, that this somewhat doubtful-looking device would respond to the etheric waves sent out by a spark coil discharge. This information seemed quite wonderful indeed of itself, and many doubts were expressed by the writer's electrical friends as to whether such a junky contraption would really attempt to work; in fact, as I recollect it, most of the conclusions were that it distinctly would not! However, one of these coherers was constructed and the next thing was to try out a scheme of pure, etheric wave wireless transmission without any ground connection. A spark coil seemed absolutely necessary, but as none was available a medical or shocking coil was pressed into service. This coil was hooked up with about 10 dry cells, and after fiddling around with it and receiving innumerable and unexpected shocks, we finally managed to obtain about 1/32 of an inch spark at the secondary. We found it necessary to connect a tin-foil and waxed paper condenser across the vibrator in order to obtain this spark, which tho small served our purpose.

At last the psychological moment arrived and everything was tuned up. No polarized or other type of relay was at hand, wherefore an old burglar alarm magnet coil, wound to 20 ohms resistance, was rigged up with a light, pivoted iron armature, so that when attracted by the electromagnet it would close a secondary circuit containing a vibrating bell. This was supposed, according to all documentary evidence on hand, to shake or tap the coherer filings back into their original state.

After spending several exciting minutes in quieting down the obstreperous coherer (not to forget for one moment the *always lively* de-coherer), it was finally possible to realize and perceive that wireless transmission was actually taking place. Not over a vast distance, like Marconi's, by any means, as the coherer was not much over three feet from the spark gap. However, this distance was finally extended to about 75 feet, after longer brass rods had been placed on the receiving and transmitting instruments to serve as antenna and ground capacities. These were old, brass-plated, iron curtain rods "swiped" from the kitchen window when mother was out to the corner grocery.



A Relic of the Author's Early Radio Experimental Days. It Bears Mute Evidence to the Fact That There Was Such an "Animal" at Any Rate, Even Though Some of the Neighbors Swore It Was Nothing but a "Fake."

After several months of experimenting with about one thousand and one (including the famous "57") kinds of filing mixtures, containing all the know metals and some that were apparently unknown, the writer and his associates finally achieved a certain measure of success. A piece of No. 14 B.&S. gauge, rubber covered copper conductor was suspended on a bamboo fishing pole secured to the edge of the roof; the lower end of this crude antenna was taken in through a porcelain tube in the first floor window sash. A 2-inch spark coil, which the "general staff" had managed to design and construct by this time, was connected up to the water pipe and the aerial. The writer arranged to have one of the family close the key now and then (mostly then), so as to send out waves from the improved antenna while he sallied forth with the *trick box*, containing the receiving instruments in order to test the working range. For a receiving antenna, a piece of No. 14 cotton covered magnet wire was utilized, suspending it from a 10-foot clothes-line prop. The ground connection for the receiving set was formed by pushing a large size screwdriver into the earth, to which a wire was attached from the instruments. Happy to relate, the coherer and decoherer behaved quite intellectually for once, and the dots and dashes came tripping in, in apple-pie order, much to the bewilderment of several sidewalk bystanders.

The instruments were working over a distance of about ½ mile on the outskirts of the city, but inversely, the crowd was not very small. A duly uniformed bluecoat, better known to *radio amateurs* as a "cop" hove in sight. After removing his hat and mopping his perspiring brow, occasioned by his recent sprint, he managed to bellow out: "Wat ya got there, Bobby?" You see I had made up this outfit quite complete, even to a wiring diagram of the instruments which was of course conspicuously shellacked in the lid of the cabinet, and to be sure it carried in large size and thoroughly legible Roman capitals the word *Wireless.* That was enough to get the "cop" thoroughly interested. In fact, after he had listened to the spasmodic ravings and sputterings of the coherer and his twin-brother, the de-coherer, for a minute or two, he flatly refused to believe anything less than that the instrument was copying low-down racing reports *via wireless.* The climax of the matter was that he gave an imperative order to "close up that contraption and away with it." A little incident of this nature, however, did not deter the present scribe or his enthusiastic co-experimenters in the least. While experiments were being carried out with this crude but gradually improving radio experimental set, a number of rather amusing incidents happened from time to time.

One of these comes to mind vividly and happened thus: One day the spark coil and key were situated on the third floor of our domicile, while the innocent looking receiving cabinet was placed on the parlor table, with its two brass curtain rods projecting from either side in their most scientific looking manner. A number of the neighbors were present on this occasion, including several electrical "sharps," who, in their spare moments, dabbled now and then into the mysteries of the electrical art, even so far as to installing their own electric door bells. When everything was ready the spark coil was operated and true to nature the receptor responded promptly with a rat-a-tat-tat on the glass coherer tube for every spark. Those present were quite astounded at the uncanny performance and flatly refused to believe that any such mystical *animal* as a Hertzian Wave existed in the universe. To cap the climax, one of them finally suggested that we close all of the hall doors on every floor, as he felt sure that the messages came down the stairs to each floor and managed, somehow or other, to enter each door, so as to propagate themselves in a direction certain to reach the ever faithful receiving instruments. And so it went, much in accordance with that golden proverb—"Where Ignorance is Bliss 'tis Folly to be Wise."

Shortly after these experiences the

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The RADIO LEAGUE of AMERICA
HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.
H. Gernsback, Manager

Activities of the New Britain Radio Club

THE New Britain Radio Club holds its meetings regularly at the New Britain, Conn., Y.M.C.A. every Tuesday evening. The fall season opened on the twelfth of September. The roster of members at present numbers 42, but only 30 are shown in the group photograph, as many of the members joined after the photograph was taken.

All the members of the club have radio sets, of which they indeed may well be proud. Messages are received regularly by many of the members joined after the pholington, Va., and from battleships located far out at sea.

Every Tuesday evening the members of the club gather in their room at the Y.M.C.A. where discussions are held on various wireless subjects. There is hardly a member owning a station but who can rightly boast of some parts of the outfits that were home-made. Indeed, there are instances where sets in their entirety have been made by certain of the young men whose mechanical ability stood them in good stead.

Francis A. Mulvihill, president of the club, has been an untiring worker for the success of the organization. His talks on wireless apparatus and long-distance sending have been highly beneficial to the members. He is one of the oldest operators in New Britain and is, therefore, possessed of a broad knowledge of wireless work.

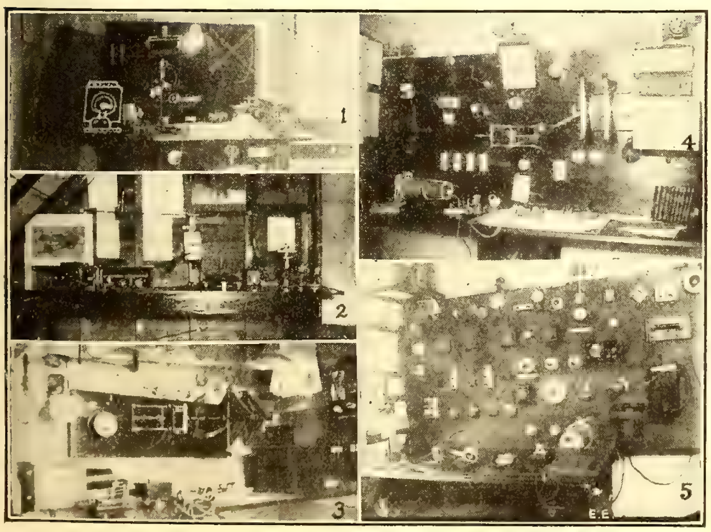
Walter J. Doyle, vice-president, and Alexander V. Bollerer, secretary, have accomplished much good work and both are well versed in wireless subjects.

Alexander V. Bollerer has devoted much of his time to the club, giving lectures on wireless and electrical apparatus, which were of great interest to the members. A 100 per cent attendance is always the rule when Mr. Bollerer is scheduled to speak.

The club has a 1 K.W. set for sending purposes. For receiving they have a 4,000 meter loose coupler and two Audions, which are operated by storage batteries. They also have six pairs of 2,000 ohm 'phones, and one pair of 3,500 ohm 'phones. The club has no official call, but has adopted the letters "MO."

The Members and Officers of the New Britain Radio Club of New Britain, Conn. The Members Have Excellent Radio Stations at Their Homes and the Club is in a Flourishing Condition

The sets shown represent the best of those owned by the members. The owners of these stations are Alexander V. Bollerer, Francis Mulvihill, Wesley Parker and Robert Yuon.



Club Members' Radio Sets. 1—Mr. Parker, 2—Mr. Yuon, 3—"Club" Set, 4—Mr. Mulvihill (President), 5—Mr. Bollerer (Secretary).

It will be recalled that Mr. Bollerer was the prize winner in THE ELECTRICAL EXPERIMENTER, the June issue. Below is a description of his set.

The sending set of the station comprises a Blitzen 1 K.W. transformer, 110 volt rotary spark gap with an oscillation transformer and suitable condenser, also a key with large, heavy contacts. The receiving set consists of the following: Long wave loose coupler, having a Murdock variable condenser shunted across the secondary; also a condenser in series with the ground lead to vary the (short) wave lengths of incoming stations.

In the secondary circuit there is an E. I. Co., sliding plate condenser in shunt; the two latter condensers are controlled by the two S.P.S.T. switches on the switchboard at the left.

Now a word about the detectors. There are four, one silicon, one galena, one Audion and a Radioson. These are connected to the loose coupler by a switch system. There are two D.P.D.T. switches employed, the leads from the secondary of the coupler running to the center of one, and the center pole of the second switch connected to one side of the other; thus allowing the operator to use any detector simply by a throw of the switch.

There are two sets of 'phones in the station, one Brandes' 3,200 ohm "Navy," shown on the table, and the other an E.I. Co. 3,000 ohm "Government" set. By means of the four point switch it is possible to connect either pair of 'phones to the detector.

The two aerials which are employed at this station may be used independently of each other, or together, as the operator so desires. One is composed of two wires, 50 feet high and 80 feet long, and the other is 375 feet long and 85 feet high; both are made of phosphor bronze wire.

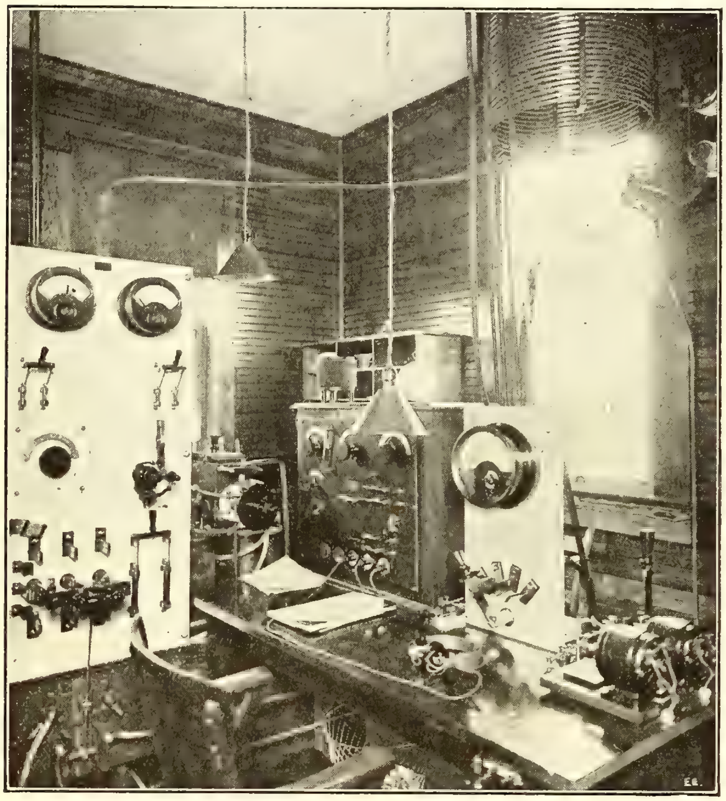
The station is located in Mr. Bollerer's bedroom and it affords him great pleasure to spend the evenings there, listening to various stations working all over the country

(Continued on page 528)

A 10 K.W. Poulsen Arc Radio Station

THE accompanying photograph shows a typical Poulsen arc radio station, which is located at Central Point, California.

The transmitting outfit consists of a 10 k.w. Poulsen arc generator, as seen on the left of the switchboard. The large insulated knob in front of the arc is used for regulating the distance between the electrodes. The oscillating circuit, which is composed of a high tension condenser located below the switchboard, while the inductance seen in the upper right-hand corner, is also used as the aerial helix. The antenna radiation ammeter is located on the small switchboard on the operating table. The four-contact knife switch below the meter is used to obtain four different wave lengths. Each switch jaw is connected to a proper number of helix turns by a heavy, insulated metal ribbon conductor. The operating key is seen on the left of the aerial control switchboard.



A Typical Poulsen Arc (Undamped Wave) Radio Station Located at Central Point, California. The Small Motors on the Table (right) Drive the "Tikker" Wheels.

The receiving cabinet is seen to the right of the arc. This is a standard Poulsen tikker receiving set, comprising two variable condenser capacities, which are controlled by insulating knobs placed on top of the cabinet. The central one operates the inductance value of the tuner, while the two lower ones on the left control the mutual inductance between the primary and secondary coils. The detector employed in this system is a tikker of the imperfect contact type. This consists of a wheel with a rough surfaced groove, driven at a high speed by an electric motor. Two fine gold wires gently press against this groove surface. There are two tikkers used in this station, one for continuous duty, while the other is used for emergency. These are seen on the extreme right of the photograph. The connections for the tikkers and phones are obtained with the jack plugs seen at the lower side of the cabinet.

Excellent results have been attained at this station and it is expected that the company will enlarge the transmitter. Poulsen arcs have been developed now ranging in size from 30 to 60 kilowatts.

COURT DECLARES AUDION AN INFRINGEMENT ON FLEMING VALVE.

The contention of the Marconi Wireless Telegraph Company of America that the de Forest Radio Telephone and Telegraph Company had infringed its rights to the sole use and ownership of the patent covering the Fleming valve detector was sustained on September twentieth in an opinion written by Judge Julius M. Mayer of the Federal District Court at New York. Dr. John Ambrose Fleming, an English scientist, invented the detector in 1905, and almost immediately thereafter the Marconi Company obtained the rights to its use.

While the invention is more than ten years old, it has never been improved upon by any other discovery for making more resonant the messages sent through the air. It was preceded by many other contrivances, variously known as the coherer, which was a glass tube filled with filings; the crystal detector, the magnetic detector and the electrolytic detector invented by Professor Reginald A. Fessenden.

In his decision Judge Mayer said that no matter what differences of opinion might exist between men of science in respect to the theories by which they accounted for the movement and action of the unseen forces, concerning which testimony had been taken during the trial of the cause, the solution of the issues at bar was not very difficult, because courts placed their decisions upon things demonstrable and could speculate as to theories concerning which even authorities did not agree. The decision read:

"Within the limits of an opinion it is, of course, impossible to analyze at length a mass of experiments, tests and theses, and an infinity of detail necessarily involved in testimony of experts in an art of this kind. But if plaintiff's (Marconi Company) theory that its own device and that of defendants (de Forest Company) operate on the same principle has not been proved, and I think it has as far as such proof is possible—at least defendant's theory has not been demonstrated and, finally, the physical facts all support plaintiff's claims."

Judge Mayer complimented Dr. de Forest on the contributions he had made to science. Then the court found for the plaintiff, dismissed the counter-claims made by the defendant, but said that there was no evidence against Dr. de Forest personally.

It is interesting to note that in the wording of the decision handed down, there is apparent the idea that the defendants quite possibly have an instrument whose mode of action involves some, as yet, undemonstrable technical details. Undoubtedly there is some minute scientific phenomena that occurs within the Audion that is not fully understood, even by the leading scientists. Several eminent savants have hinted as much in a number of instances.

The Judge admits that the introduction of the grid electrode by de Forest was a most important advance in the art—a truth emphasized by the fact that since its first disclosure tens of thousands of grid Audions have been employed the world over, as against a few hundred two-electrode lamps—and almost no genuine rectifiers as disclosed in the original Fleming patent.

During the course of the trial the de Forest Co.'s experts demonstrated that electrical rectification between the hot and cold elements of an Audion played no essential part whatever in the operation. Bulbs were tested having one, two, and finally three incandescent electrodes—i.e., filament, grid, and anode, all incandescent, heated from separate batteries. The actions and sensitiveness of these Audions was unchanged as grid and then anode were brought from cold to the same temperature as the filament. In this state either electrode could be made to play the part of "filament," "grid," or "anode"—indifferently; thus proving that the rectification principle on which the Fleming Valve avowedly does and must operate plays no part whatever in the Audion.

Dr. Lee de Forest, president of the de Forest Radio Telephone and Telegraph Company, said that an appeal would be taken from Judge Mayer's decision by his company. He added that while the Marconi Company also was found to have infringed, he believed they would not appeal, since the royalties they might be able to exact from the de Forest concern for infringement of the Fleming valve patent would be far in excess of the amount they would be called upon to pay for infringing on the Audion amplifier. The latter, he said,

was widely used, particularly by the American Telephone and Telegraph Company on its trans-continental lines and by amateur wireless operators all over the country, while the United States Government had bought more than 10,000 of them. The infringement decision, he explained, lay in the fact that the Audion amplifier made use of an incandescent electric bulb, though this was employed in taking practical advantage of a principle altogether different from that upon which the Fleming valve was based, though the latter was the first device embracing the use of an incandescent lamp to be patented. Dr. de Forest said further that he believed the Marconi Company would not attempt to force discontinuation of the Audion device, as, he said, it had proved a far more satisfactory amplifier than the Fleming valve.

NEW SHIP RADIO RULES IMPOSED.

New instructions to masters of ships of the warring nations regarding the radio outfits of ships have recently been issued by the government authorities as follows:

"Upon arrival inside of the three-mile limit, disconnect aerial. No further use of radio set permitted except in an emergency or as stated below.

"Current off the radio, both emergency and main set.

"Plant must be available for inspection at any time night or day.

"In case repairs to the set are necessary the radio neutrality inspector must be communicated with at once, as in case any seal may be in doubtful condition.

"No tampering with seals after they have been placed, except by a radio neutrality inspector or duly authorized person.

"Sets after clearance may be placed in condition for use upon arrival at the three-mile limit, upon obtaining permission of the collector of the port.

"Vessels calling for bunkers whose stay is less than twenty-four hours are not ordinarily required to disconnect, nor is the set sealed, but they must not use it for sending or listening in."

AEROPLANE RADIO TEST.

What is regarded by army aviators in San Diego as one of the most notable achievements in American military aeronautics was recorded during the past summer, when Captain Clarence Culver of the San Diego aviation school, kept in radio communication with North Island, San Pedro and Dominguez Field in Los Angeles during a flight to Santa Monica and return.

The distance covered was approximately 230 miles and the messages were sent at ten-minute intervals. Lieutenant W. A. Robertson, who handled the receiving instruments at the army aviation school, said that every message was recorded with amazing clearness.

Captain Culver, whose military aero tractor was piloted by Sergeant William Ocker, left the North Island aerodrome at 9:30 o'clock in the morning. Flying at an altitude of one and a half miles, the aviators circled over Los Angeles and then headed for their destination point, Santa Monica.

The radio set used by Captain Culver was invented by himself. The apparatus, weighing less than forty pounds, was attached to the lower section of the aeroplane, and the power for transmission was derived from a generator that was specially constructed and driven by the aeroplane engine.

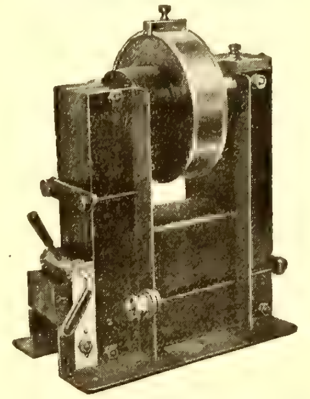
MARCONI SAYS WE'RE SAFE.

Our wireless friend Marconi says the United States can't be invaded. Yes, and there was a time when the wireless telegraph was looked upon as an impossibility, Guglielmo, my boy.

NEW WIRELESS TRANSFORMERS.

A Western manufacturer has placed on the market a new type of wireless transformer for amateur use.

The experience which this company has had in the wireless field is used to good advantage in the several new mechanical, electrical and magnetic features which appear in the new type as improvements over the old one. From a mechanical standpoint, the advantages are that all heavy and cumbersome castings have been eliminated and the structure is of pressed or stamped sheet steel and brass. This eliminates the possibility of breakage and reduces the weight approximately 2 per cent. Reduction of the cross section of the frame-work naturally decreases the sectional area open to the eddy currents. This feature, therefore, improves the efficiency of the device. The magnetic circuit of this new transformer is similar to previous designs, in that the external magnetic shunt is used. There is, however, one very important improvement that, instead of varying the entire magnetic shunt circuit by means of a spring and wing nut as heretofore, the magnetic shunt circuit is rigidly and securely held in place, the only movable portion being a small "V" shaped laminated steel tongue which moves in and out of the shunted magnetic circuit, varying the width of the air-gap and thus yielding any required regulation. The movement is accomplished by means of two geared wheels that engage either side of the tongue. On the same shaft is also placed an eccentric cam which readily locks the tongue in any position. The movable tongue is graduated so that air-gap can



Wireless Transformer with Unique Impedance Adjustment.

be readily adjusted for any current input desired.

The primary and secondary windings are disposed on opposite legs, the primary being on the lower one. This high tension coil is extremely well protected mechanically by a band of heavy metal which covers the outer surface. This band is so constructed as to eliminate corona effects, this in turn reducing the liability of flash-over to a negligible quantity. The high tension coil is wound in layers with special insulated paper between, the edges of this paper being folded back, thus preventing the wire from slipping out of place.

There are no high-tension bushings or cable to this transformer, the metal shield of the secondary windings forming one terminal. One valuable feature of this transformer is that it is moisture proof. To demonstrate this fact one of these transformers was immersed in water. After being taken out the faces of high tension coil were dried with waste and transformer when tested under this condition, indicated no insulation weakness.

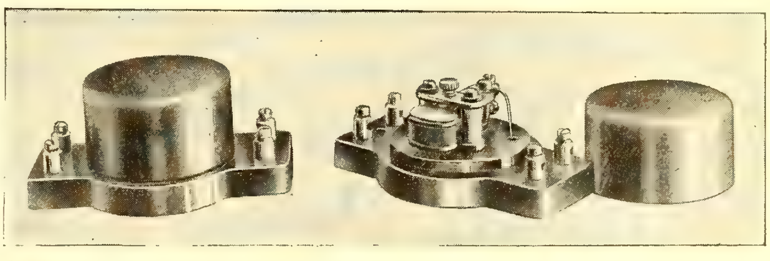
GALLETI WIRELESS TO BE DEVELOPED.

The Indo-European Telegraph Company, Ltd., London, England, states that owing to the continued interruption of the company's route during the whole of 1915, the actual receipts were confined to local traffic. It has been impossible to make final arrangements for the reestablishment of the route. Under the existing arrangements with other companies and administrations the company's receipts have not been prejudicially affected, but the directors foresee a diminution in the receipts for 1916.

On this account the company thinks it advisable to develop the Galleti wireless patents and to this end has entered into a new combination of interests with the firm of Creed, Bille and Company, Ltd., of London for the development of the wireless side of the business, for which purpose the Creed Company will be enlarged. It is the intention of the Indo-European Telegraph Company to utilize the wireless art in connection with its cable and land line system to span the gaps so long interrupted through the countries at war.

NEW HY-TONE RADIO TESTING BUZZER.

The radio experimenter and operator is always on the lookout for a reliable, hy-note testing buzzer. Here is the latest product of this type, and it is capable of operating on one dry cell. It simulates the pitch or note of high frequency radio transmitters, and will operate continuously for hours at constant amplitude without changing its period. It is easily adjusted over a wide range. It measures 2¾ inches long by 1⅝ inches wide, by 1⅛ inches high and weighs but 1½ ounces. The two pairs of binding posts (one pair for battery connection and one pair for connection across the break) are arranged outside the case so that connections can be made without removing the cover and no holes need be bored for bringing out wires when mounted on a cabinet or table.



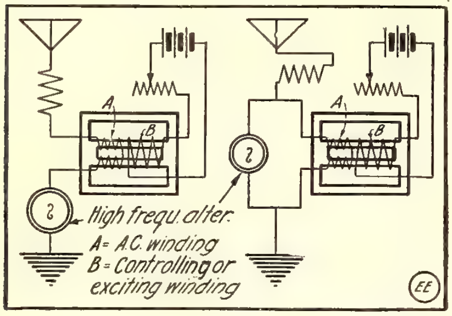
High Frequency Buzzer Recently Perfected for Testing Radio Detectors, Besides Serving as a Source of High Frequency Oscillations for Measurements.

A condenser and inductance connected across the contact points of this buzzer provide a source of oscillations of constant amplitude and constant wave length for laboratory and testing purposes. Such an instrument should fill a long-felt want in experimental radio laboratories, as the home-made test buzzers either have a "frog" tone or else they have a note that passes thru several octaves of the musical scale every now and then; said now and then being about the time you are ready to balance your wave meter for an accurate measurement.

The six state capitals of Australia have been connected by wireless telegraphy.

A NEW MAGNETIC AMPLIFIER FOR WIRELESS PURPOSES

One of the principal functions to be performed in modern radio work, especially where large quantities of power are to be regulated and controlled, as in wireless telephony, is that involving *amplification.*

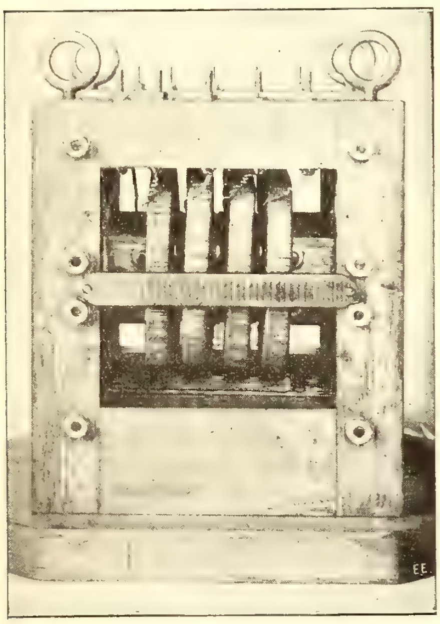


Schematic Arrangement of New Magnetic Amplifier Which Operates on a New Principle of Unbalancing the Magnetic Flux Due to D. C. Excitation.

Amplifiers represent one of the leading factors in modern radio research work. They have many applications indeed, and one of the latest is the magnetic amplifier, which was recently described before the Institute of Radio Engineers by Mr. E. F. W. Alexanderson, of the General Electric Company.

This scientist, as is well known, has performed a vast amount of commendable research work in the radio field, particularly on extra high frequency A. C. generators, delivering oscillating currents with a periodicity of 200,000 cycles per second.

Referring to the accompanying diagrams, Figs. 1 and 2, we have two magnetic windings A and B related to one another magnetically and grouped on a laminated core structure in the peculiar fashion shown, there being a slot left in the central leg of the iron core. It is apparent that there can be no direct transformation of energy from one winding to the other for the reason that each turn in the exciting winding B, includes both the positive and the negative branches of the flux produced by the alternating current winding A, which is connected in series with the high frequency alternator or other source of oscillating



Appearance of 75 K.W. Alexanderson Magnetic Amplifier.

current. Hence there is no voltage induced in the winding B. However, the current in either of the windings A or B influences the permeability of the common iron core, and therefore changes the inductance value of the other winding. Should the current flow in either winding be sufficient to saturate the iron core, it is therefore rendered practically non-magnetic and the inductance of the second winding is reduced to the value it would have, if the coil included only air. When, however, a current flows in the other winding which gives a magneto-motive force equal and opposite to the first, the iron core is rendered magnetic again. As the two divisions of the A winding are wound relatively opposite to the B winding, the one branch will oppose the ampere turns of B on one-half cycle and the other branch during the successive one-half cycle.

The opposing ampere turns must be at least equal to the ampere turns in the winding B in order to have any flux variation in winding A.

The relations of currents in these windings is substantially the same as between the primary and secondary current in a transformer, although in this case one is an alternating and the other a direct current, or a current of a different frequency. It is thus obvious how the current flow in winding A can be regulated in proportion to the controlling current in winding B. When the magnetic amplifier is used in shunt to a high-frequency alternator, having a solid steel rotor, it has the immediate object of controlling the voltage rather than the current. The aggregate of the constant-field alternator and the stationary device A B has the effect of a machine with variable field excitation.

As indicated in the diagrams, it is possible to connect the amplifier either in series with the alternator or in shunt to the alternator. Of these two arrangements, the shunt connection is preferable. Mr. Alexanderson's paper develops in some detail the theory of the ratio of amplification, together with characteristic curves for series and multiple connection of the two alternate current windings with various condensers and tuning inductances. Various arrangements of this amplifier in connection with a solid steel rotor, radio frequency alternator, are shown, notably those in series with the alternator and those in parallel. Short-circuited condensers are connected to each of the radio frequency coils. A shunt condenser across both coils and their short-circuiting condensers increase the sensitiveness. Another condenser inserted in series with the entire amplifier is employed to obtain linear proportionality of amplification and increased sensitiveness. The ratio of amplification is found to be proportional to the ratio of the frequency of the radio current to that of the controlling current. For telephone control the amplification ratio varies from 100 to 1 up to 350 to 1. The paper describes, with oscillographic curves, the actual effects occurring in controlling the out-put of a 75 kilowatt radio frequency alternator.

CONDUCTIVITY OF COPPER.

The American Institute of Electrical Engineers recommends the following as normal values for standard annealed copper:

(1) At a temperature of 20°C., the resistance of a wire of standard annealed copper one meter in length and of a uniform section of 1 square millimeter is 1/58 ohm = 0.017241....ohm.

(2) At a temperature of 20°C., the density of standard annealed copper is 8.89 grams per cubic centimeter.

(3) At a temperature of 20°C., the "constant mass" temperature coefficient of resistance of standard annealed copper, measured between two potential points rigidly fixed to the wire, is 0.00393 = 1/254.45.... per degree centigrade.

(4) As a consequence, it follows from (1) and (2) that, at a temperature of 20°C. the resistance of a wire of standard annealed copper of uniform section, one meter in length and weighing one gram, is (1/58) × 8.89 = 0.15328....ohm.

Copper Wire Tables. The copper wire tables published by the U.S. Bureau of Standards in Circular No. 31 are adopted.

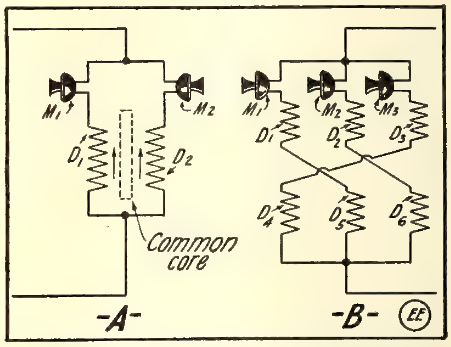
USING TYPEWRITER SPACE BAR TO LEARN CODE.

The wireless "bug" who during his hours of sanity is employed in an office can keep in fine practice by operating the *space bar* on a typewriter, which, because of its sensitive touch and loud after-click, answers very well as a substitute for a *key*. The beginner also will find this a practical way of learning.

Contributed by JOHN T. DWYER.

CONNECTING MICROPHONES IN PARALLEL

Dr. Rudolph Goldschmidt has given in British patent specification No. 15,915, 1912, a method of connecting microphones so as to be worked in parallel satisfactorily. As it is impossible to make two microphones that will remain perfectly alike electrically, it has hitherto been advantageous to use microphones in series. Goldschmidt's invention overcomes the difficulty for a pair of microphones by placing in series with each microphone, a coil so wound that the surging of the compensating currents, which always arise through unequal operation of instruments, is prevented by the mutual inductive action of the coils.



The Goldschmidt Scheme for Hooking Up Microphones in Parallel, Where Extra Heavy Currents Are to be Handled.

Fig. A, shows the arrangement where, M_1 and M_2 are the microphones, and D_1, D_2, are coils wound oppositely on a common core. Equal currents down the coil cancel each other's magnetic field, but a circulating current would build up a field, and, therefore, experience a considerable choking effect. When more than two microphones are to be connected in parallel they may be caused to work uniformly by pairing them and applying the above method.

However, a more advantageous arrangement is that shown in Fig. B, where coils D_1 and D_4 act on each other, and the remaining coils are paired similarly.

Still another method is given in the specification. A coil in series with each microphone acts on one and the same secondary current. If the microphones operate unequally, the presence of the secondary tends to choke the circulating current; if they operate equally the secondary current tends to neutralize the self-inductance of the coils. These methods promise to be of importance in radiotelephony thinks Dr. Eccles, the well-known radio scientist.

Telephones are rapidly displacing telegraph systems on several important railroads.

The How and Why of Radio Apparatus

Each month we will describe one particular instrument used in either the radio transmitting or receiving set, explaining just how it works, and why. We have received so many requests from new readers asking for such explanations, that we have decided to publish this matter in serial form. In the course of several issues all of the principal transmitting and receiving apparatus will have been covered. The subject for the first paper is the INDUCTION COIL, that much abused and misunderstood device with which all electrical men are more or less familiar, but which seems to be a complete mystery to the embryo electrician.

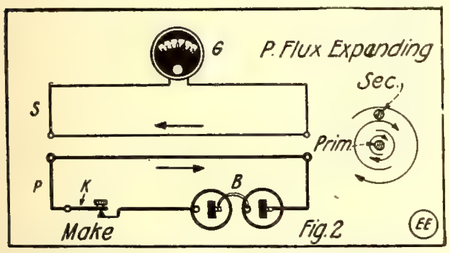
NO. 1—THE INDUCTION COIL.

THE induction coil is in general made up of two distinct windings or coils which are usually arranged one over the other, having an annealed iron wire core passing through their center, as shown in Fig. 1.

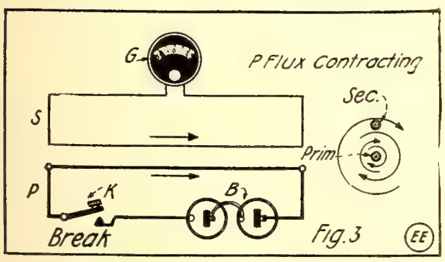
The diagram at Fig. 1 shows in a schematic manner the arrangement of an induction coil designed to produce sparks or high voltages. Usually, at least in wireless work, the primary, or heavy wire winding is placed over the iron wire core. Suitable insulation, consisting of a few layers of insulating cloth or paper, is placed over the iron core preparatory to winding on this coil. After the primary has been completed, which generally consists of two to three layers of comparatively heavy wire, it is carefully insulated by winding over it several layers of insulating cloth; in spark coils above one quarter inch rating it is preferable to place a hard rubber tube over it.

The secondary winding is wound on over this tube, and it is usually somewhat shorter in length than the primary.

Now, when the primary switch of such a coil is closed, the battery current passes



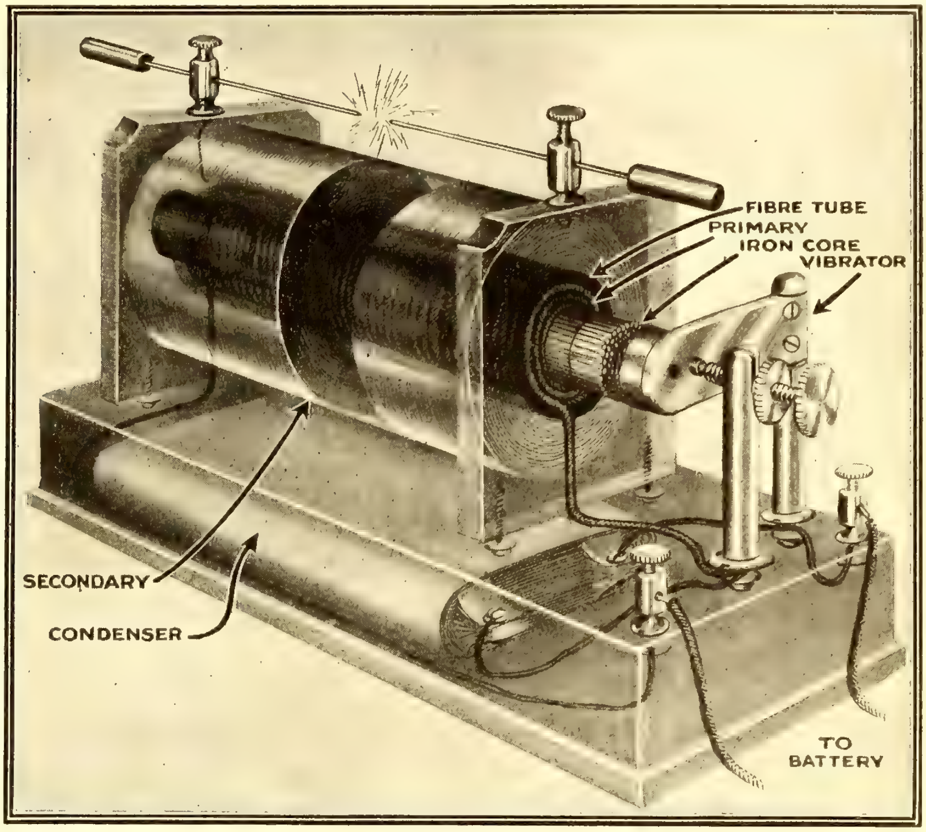
Showing Direction of Induced Current in Secondary at "Make" of Interrupter.



How the Secondary Induced Current is Reversed in Direction at "Break" of Interrupter.

through the first winding on the core and magnetizes it. This attracts the iron armature on the vibrator spring, as shown in Fig. 1, and when this spring breaks contact with the platinum tipped screw in front of it, the circuit is opened. At this juncture there is induced in the secondary winding a very powerful current. The spring-actuated vibrator returns to its former position in the fraction of a second and the process is repeated all over again.

Small induction coils used for medicinal purposes, such as the treatment of rheumatism, etc., are practically never fitted with a condenser across the vibrator. All spark

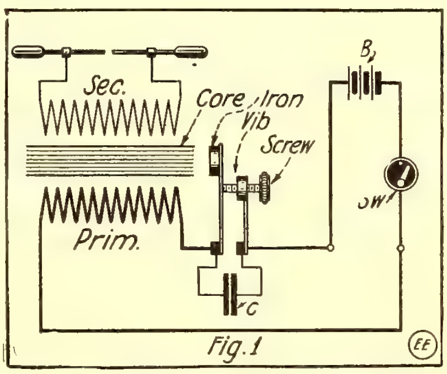


X-Ray View of an Induction Coil, Showing Clearly the Relative Position of the Core Windings, the Vibrator and its Condenser.

coils, however, are invariably equipped with such a condenser, which reduces the spark at the vibrator contacts and also greatly enhances the intensity of the induced secondary current.

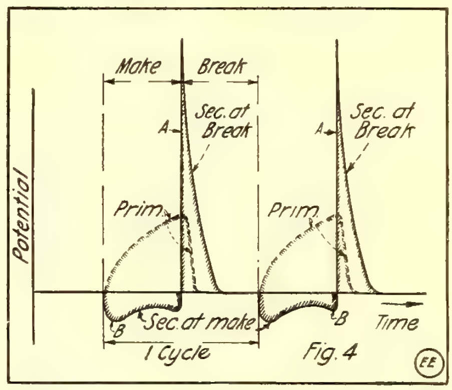
It is generally considered, and is stated in most text-books on this subject, that the voltage of the current induced in the secondary winding will be proportional to the ratio existing between the number of turns of wire in the secondary winding and the number of turns in the primary. This ratio holds true for regular alternating current transformers, but it does not hold exactly true for ordinary induction coils, as the potential of the secondary induced current is, to a great extent, proportional to the speed of the vibrator interruptions.

We may examine the phenomenon taking place at both the *make* and *break* of the



Circuits of "Spark" Coil, Which Always Have a Condenser Across the Interrupter as Shown.

spark coil vibrator, by referring to Figs. 2 and 3. As will be evident from Fig. 2, the direction of the induced current in the secondary is opposite to the direction of the primary current, during the *make* period at the vibrator. This is in accordance with the law of Lenz, which states *that the direction of a current produced by electromagnetic induction, is always such as to*



Oscillograph Curves of Primary and Secondary Currents at "Make" and "Break" of Primary Interrupter of Two-inch "Spark" Coil.

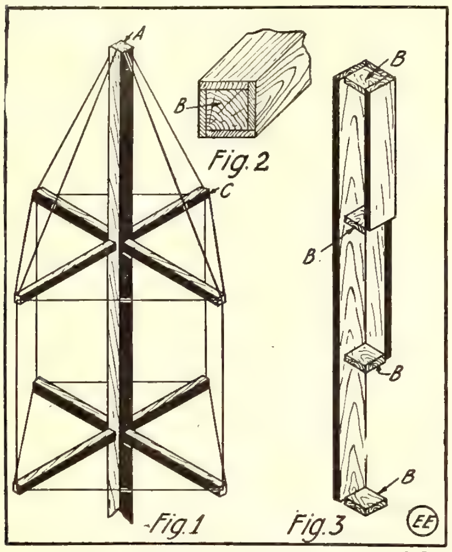
cause it to oppose the motion by which such currents were produced. The half wave of secondary current induced at *make* is not of very high value, and is termed the *inverse current.* The phenomenon taking place at the *break* of the primary circuit vibrator or interrupter is exhibited at Fig. 3. Here the secondary current passes in the same direction as the primary current. It is, moreover, of very high instantaneous value and possesses much greater energy than the inverse half wave B, shown graphically in Fig. 4.

This may seem at first quite contradictory to the statement of Lenz's law, but up-

(*Continued on page 523*)

CONSTRUCTION OF A REINFORCED WOOD MAST.

To the amateur desiring to raise his aerial to a greater height than his present single stick mast will permit, the following construction of a reinforced mast or tower is



A Good Idea for Bracing Aerial Masts and Inexpensive to Apply.

offered. It may be built to any reasonable height and can be extended to a greater height at any time the amateur chooses.

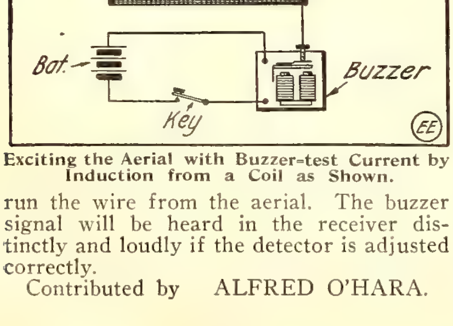
The mast A (Fig. 1) is composed of two strips of wood ½"x3"x12" nailed together as shown in Fig. 2, forming a hollow box with the exception of blocks B (Figs. 2 and 3) placed every three feet within the mast to keep it square. In starting the construction of the mast, boards of the above dimensions, three feet, six feet and nine feet long are nailed together as shown in Fig. 3, and the construction continued with twelve-foot boards until the mast is of the desired length. It is then finished with shorter pieces as above. This brings a single joint at each three feet of the mast.

The braces C (Fig. 1) are one inch square by one and one-half feet long and may be either solid or of box construction. Four are nailed to the mast every three feet and wired as shown in the diagram with doubled iron wires which are twisted until tight. The wires are attached to the ends of the braces with nails or screw-eyes. The entire tower should be given a coat of white lead paint for a neat appearance and to prevent the wires from rusting. It should be guyed by at least three guy wires spaced 120 degrees apart.

Contributed by H. W. OFFINS.

INDUCTIVE BUZZER TEST FOR DETECTOR.

Wind a layer of wire around a cardboard tube about 1 inch in diameter and 3 inches long. Connect the wire to the adjustment screw of the buzzer as shown in the illustration. Through the center of the tube



Exciting the Aerial with Buzzer-test Current by Induction from a Coil as Shown.

run the wire from the aerial. The buzzer signal will be heard in the receiver distinctly and loudly if the detector is adjusted correctly.

Contributed by ALFRED O'HARA.

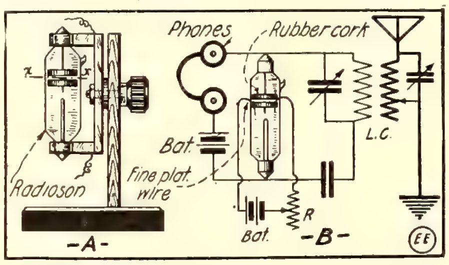
EXPERIMENTS WITH A RADIOSON DETECTOR.

The latest type of sealed point detector, termed by its makers the *Radioson*, has been the subject of very little experimenting. This detector works very well and is unusually sensitive, yet too many amateurs fail to realize the broad field of research opened to them by this instrument. They merely mount it on their receiving set, marvel at its efficiency and naturally do not try to improve its operation, thinking it perfect. The author recently conducted a series of experiments that rendered the instrument even more sensitive and may be of interest to owners of similar detectors.

These experiments were conducted on a cartridge that had been in use for a year. The first noticeable detail of the Radioson was the fact that it was impossible to get at the sealed-in platinum point and steps were taken to render this possible. Referring to Fig. A, the glass was carefully filed at the point X, and a light tap served to part the glass tube.

The next step was to obtain a rubber cork, drill a hole through it to pass the upper electrode, and by using this cork as a coupling the entire cartridge was re-assembled.

A new stand was constructed as shown in Fig. A base of suitable size was used and an upright was mounted thereon. A holder for the cartridge was fashioned from a strip of wood; two clips were used to clamp the cartridge. The holder was pivoted to the upright, with flexible cords run-



Method of Mounting and Connecting the Radioson Detector for Improved Results.

ning to the clips. The sketch shows the device very clearly and will facilitate the construction.

With this device it was possible to place the cartridge at any angle desired. With the detector in the circuit and signals coming in, the knob was slowly turned; the signal strength does not change at once but when it reaches a certain point the intensity of the signals suddenly increase to an almost unimaginable extent.

The writer has since determined that this angle varies with different cartridges, no doubt due to slight irregularities in the glass around the sealed-in point. The action may be due to some capillary action between the glass and the hydrogen gas, since bubbles do not come off as frequently as before. With such an arrangement it is possible to tune out weak interfering stations by merely turning the knob to the proper position.

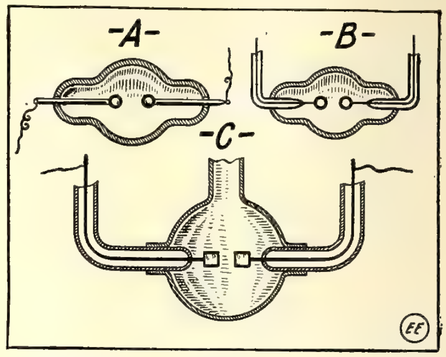
The final experiment was to provide for some means of agitating the liquid. To do this, short lengths of platinum wire were forced through holes in the cork as shown in Fig. B, flexible cords being attached to the protruding ends. The circuit used is also given for the benefit of those not acquainted with this little "kink." The extending seal of the cartridge was broken off to allow any gas formed to escape.

The results with a common Radioson may be excellent, but the signals obtained with these improvements are astounding. With a 65 foot aerial, 55 feet high, eight wires, loose coupler, variables, 2,000 ohm 'phones, NAR and NAX come in loud and clear. I heard an amateur in Michigan with a 1 K.W. set; everything on the coast "drums in" at night.

Contributed by FRANK M. KUSS.

LONG SPARKS AND QUENCHING TUBES.

Max Wein has shown that quenched spark excitation can be affected by aid of long sparks, if the coupling between the



A New System of Utilizing Long Sparks in Radio Involves Passing Them Thru Quenching Tubes.

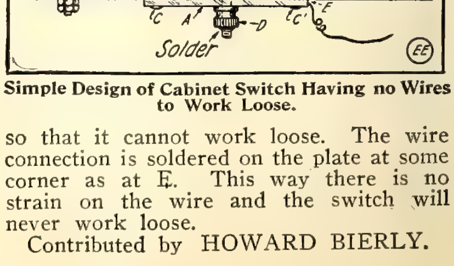
primary and secondary circuits is nicely adjusted, states Dr. Eccles in his work, *Wireless Telegraphy and Telephony Hand-book.* Sparks between 0.5 and 2.0 cm. can be used; silver electrodes are best, magnesium worst, as regards the effective value of the secondary oscillations. But the coupling has to be loose, and therefore the building-up period is about as long as the decay period, with impure oscillations as a result. These defects may be partially removed by multiple gaps and immersion in hydrogen, but the use of quenching tubes is much superior.

A quenching tube is merely a short (evacuated) Geissler tube. Several types are shown in the illustration. The best pressure is between 0.1 and 1 mm. of mercury, and hydrogen gives rather better quenching than air. The best metal for the electrodes is silver. The tube is placed in the primary circuit, near the ordinary spark gap. With a primary circuit, comprising a condenser of 0.86 x 10^3 M. F. and an inductance of 40,000 e.m., together with a nearly equal secondary circuit, the critical coupling was about 10 per cent. Capacity change has little effect on efficiency, which is high. Thus with a spark gap of 2.5 cm., between silver discs 5-cm. diameter and a quenching tube with silver electrodes, an efficiency of 84 per cent was reached, the secondary R.M.S. current being 4.4 amperes. Wien has shown that this method of shock excitation can be easily and effectively carried out with power inputs of about 1 K.W.

USEFUL SWITCH WRINKLE.

Here is a plan for fastening wire to switches on loose couplers that I have found convenient.

F is the panel. A is a brass or copper plate fastened to panel by screws C and C'. D is a nut on the screw from the knob and is fastened by a drop of solder



Simple Design of Cabinet Switch Having no Wires to Work Loose.

so that it cannot work loose. The wire connection is soldered on the plate at some corner as at E. This way there is no strain on the wire and the switch will never work loose.

Contributed by HOWARD BIERLY.

Radiation Current In Radio Antennae

By C. L. Whitney

Many amateurs have often been puzzled over this question: "How many watts do I radiate?" Of course we know that we cannot take the approximate voltage (in the aerial) and the amperage, and multiply to get the watts; for example: We have say, 10,000 volts at the antenna lead, and our hot-wire ammeter reads 5 amperes. Now if we calculate the watts by the ordinary method we would have 50,000 watts or 50 kilowatts, which we know cannot be correct as we only have a 1 K.W. transmitting set. We can never get over 100% efficiency, while if we did get 50 K.W. in the aerial, we would be getting 5000% efficiency, or the aerial current would be 50 times as much as we draw in the transformer.

Many of us have not been able to figure out, even approximately, what our radiation really is, and the author hopes that the following formulae will prove of value:

The watts radiated from a flat-top aerial may be found from the equation:

$$P = 1578.2 \frac{h^2}{\lambda^2} a^2$$

Where:—P=power radiated in watts.
h=height of aerial (in feet).
λ=length of emitted wave (in feet)
a=amperes, as measured by hot-wire ammeter in aerial circuit.

This formula is used where the antenna capacity is mostly in the flat-top. For example:

Supposing we have a flat-top aerial 100 feet high with leads brought down from the center. Our wave-length is, say, 600 meters or approximately 2,000 feet. The hot-wire ammeter reads 5 amperes.

$$\text{Then:—}P = 1578.2\left(\frac{100^2}{2000^2} 5^2\right)$$

$$\text{or } P = 1578.2 \frac{10,000}{4,000,000} 25 = 88.6375 \text{ watts.}$$

Therefore, with a flat-top aerial 100 feet high on 600 meter wave-length we are radiating approximately 88 watts.

The watts radiated from a vertical aerial is given by the formula:

$$P = 640 \frac{h^2}{\lambda^2} a^2$$

This formula is applied in the same way as the first.

Now we can calculate the power radiated in still another way, as long as we know the radiation resistance of the aerial, and the number of amperes.

$P = Ra\ A^2$

Where;—Ra=radiation resistance in ohms.
A=Amperes, measured by hot-wire ammeter in ground or aerial lead.

To find the approximate radiation resistance (Ra) of a flat-top aerial we use this formula:

$$1600 \frac{h^2}{\lambda^2} = Ra \text{ (in ohms)}$$

Where:—h=height of aerial (in feet)
λ=length of emitted wave (in feet).

Now compare your transformer input (in watts) with your aerial radiation, (in watts), and you will see that radio apparatus is not so efficient as many have been led to believe. As mentioned before, we have a 1 K.W. set which radiates 5 amperes in the aerial (which is 100 feet high).

1 K.W.=1,000 watts. (This is the transformer input.)

According to our calculations the radiation is 88.6 watts. It is easily seen that the set is only 8.8% efficient (from power input to aerial). If we improved our station in some way, other than by raising the transformer input, and we obtained 6 amperes instead of 5, we would radiate 142 plus watts; our set would then be nearly 15% efficient.

We can increase the radiated power by increasing the height of the aerial. Thus if our aerial was 200 feet high instead of 100 feet and the hot-wire ammeter reading remained the same (5 amperes) we would radiate 4 times as much as before or about 375 watts.

Radiation may also be increased by increasing the number of wires in the flat-top, but the most effective way to increase the radiation (and incidently the range of the station) is to increase the height of the aerial. We could build an aerial say 100 feet long, at a distance of about 10 feet from the ground, and when we connect our transmitting set to this, the hot-wire ammeter will show a higher reading than when the set was connected to a high aerial. However, by the above formulae we can readily see that the power radiated (watts; not amperes alone) is not high, and naturally the distance we can transmit is also curtailed very much.

It is now plain why in some cases one station (call this station No. 1) radiates say, 8 amperes, and has a range of say, 200 miles; while another station (call this station No. 2) radiates say, 5 amperes and works 300 miles as easily as station No. 1 works 200. If you will notice carefully just how each station's aerial is built and how the leads run (if parallel to iron masts, stacks, etc., in case of a station on a ship) you will find that the aerial of station No. 1 is either low, or that the leads run parallel to some grounded object and therefore although 8 amperes leaves the station, much of it is lost to the grounded objects. Again the aerial may be low and thus the WATTS radiated is low, although the hot-wire ammeter shows a high reading. The practice of using hot-wire ammeter readings to compare two or more stations is very misleading, as becomes apparent.

The author has tested a United-Marconi 1 K.W. set which was practically 15% efficient (from transformer input to aerial), radiating about 150 watts in the aerial, and with which it was possible to work from 400 to 500 miles in the daytime with the sun shining, although the aerial was only about 90 feet above the water. This set was installed on an Army Transport which took part in the operations during the 1914 Mexican trouble.

A HINT FOR COPYING N A A WEATHER REPORTS.

In connection with copying N A A Weather Reports I have memorized the following signs which aid greatly in taking the reports down, especially when they are sent fast. After trying them out a few nights, I found it very easy to get the reports complete, as these are a form of shorthand for the more commonly used words in the reports. Here they are:

North ^	East >	From ⊂
Northeast ^¹	West <	To '
Northwest ¹^	Moderate /	And –
South V	Winds \	Great Lakes ⊃
Southeast V₁	Atlantic I	Pacific II
Southwest ¹V		Coast o

These words occur most frequently in every report, for instance:

^¹ \ ⊂ ⊃
Northeast winds from Great Lakes at 30
o
miles an hour to Florida coast.

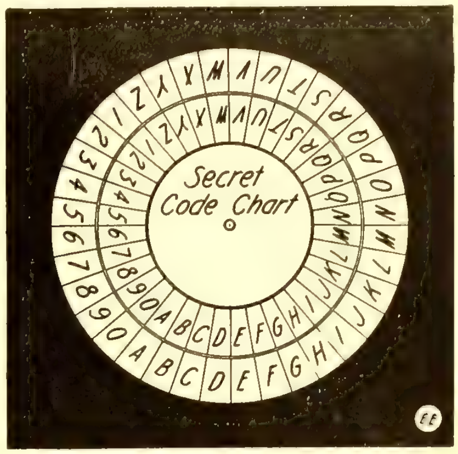
After a few days practice it comes easier than to write them down.

Contributed by FRANK TALONE.

A "SECRET" CODE CHART.

Now that there are so many amateurs in the wireless field, it is often found very convenient to use a secret code for any communication which it is desired to keep more or less private.

The following described "secret" code chart has the great advantage of containing many different combinations which may be easily deciphered.



To Operate This Secret Code Chart, Rotate the Inner Disc Until the Desired Letter Is Opposite the Letter on the Outer Disc to Be Sent by Code

Two circular disks are cut from cardboard, one about 1¼ inches less in diameter than the other. The circumference of each is then divided into 36 equal parts and radial lines are drawn through these points. Holes are then cut through the centers of the disks and the disks put together and fastened loosely, with an "easy rivet," so that the disks may be rotated independently.

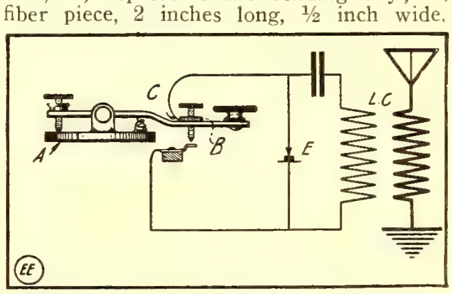
Letters are marked on the circumference of the disks in the spaces, as indicated in the accompanying illustration.

To use: Rotate the inner disk to the combination desired. Then send the letter on the *outer* disk, opposite the letter which forms the word on the *inner* disk. This gives the combination. Then substitute the letters on the outer disk for the adjacent letters on the inner disk. Each card gives 36 different combinations. Various cards may be made with the letters in different sequence.

Contributed by
RAYMOND S. SUTCLIFFE.

SIMPLE DETECTOR SHUNT.

Many amateurs are bothered by the detector being knocked out while sending. This is very annoying and can be remedied by this device. Referring to the illustration, A, represents the sending key; B, fiber piece, 2 inches long, ½ inch wide,



Auxiliary Contact Arranged on Key to "Shunt" Radio Detector While Transmitting a Message

drilled with 2 holes as observed; C, contact screw from old key; a bottom contact mounted on fiber block; E, detector. This device short-circuits the detector during sending.

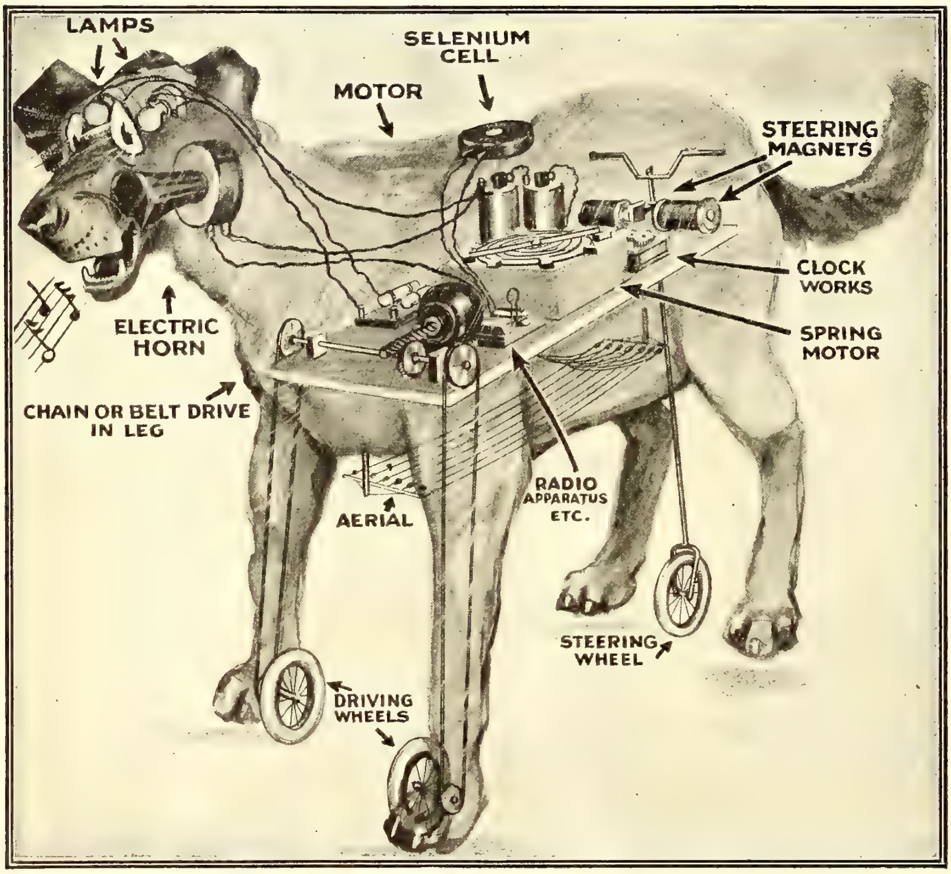
Contributed by
WARNER N. CROSBY.

THE CONSTRUCTOR

A Wireless "Hound" That Dogs Your Foot-Steps

By F. A. Steinbrook

HOW would you like to have an electric "pup" that will follow you around like all faithful quadrupeds of the genus "hunt." Well, here's how:



Here we Have the Experimenters' Delight—a Wireless "Hound" That Will Obey Your Most Ardent Desires. It Can Be Operated by a Flash-light Ray Thrown on a Selenium Cell or by Wireless Waves Actuating a Coherer and Relay.

To make this faithful "canine" we will first require a selenium cell, 2. It is placed on top of the electric dog, so it becomes easy to focus light rays on it at any desired time. When rays of light are focused on the selenium cell, making it a conductor of electricity, it closes the circuit to the polarized relay, 3. In turn, this relay closes the circuit to the selective device, 1. A two point switch, 4, is placed in the circuit; when the switch blade is placed on point No. 1, the selenium cell is in circuit; when placed on point No. 2, the coherer is in circuit. (The selective device was made from a phonograph works.)

The polarized relay 3, closes the circuit to the magnet 12, on the selective device, which releases the rotator, 22, allowing it to rotate to the right as long as the circuit is closed. There are six stops on the selective device. When the circuit to the selective device is opened, by removing the light rays from the selenium cell, the magnet, 12, releases and the rotator stops at one of the six selections. When the rotator is halted at stop, 6, this is the neutral position. If the light rays are flashed on the selenium cell and immediately released, the rotator turns to stop 1; the pressure of the rotator against stop, 1, closes a circuit and starts the motor, 5. This in turn starts the dog in a forward direction. (The driving arrangement is shown quite fully in the drawing.)

When the rotator is in this position, it makes another contact with the contact rings, 11; this also closes the circuit to the motor, and the motor is kept in circuit until the rotator reaches stop 5. Then the circuit to the motor is opened, when his riverence, the "pup," stops his forward peregrinations.

A second flash of the light rays on the selenium cell, and the rotator moves again and halts at stop, 2, closing the circuit to the solenoid, 9; this turns the wheel, 21, to the left, and the dog moves in the same direction.

A third flash of the light rays on the cell and the rotator moves to stop, 3, closing the circuit to the solenoid, 8. This has the effect of turning the dog to the right.

A fourth flash and the rotator moves to stop, 4, closing a circuit to the electrical horn, 10, adjusted to give a growling note as if it wanted more frankfurters.

A fifth flash and the rotator moves to stop, 5, closing a circuit to the automatic flasher, 7. This flasher opens and closes the circuit to the electric lights, 19, or "eyes" of the dog, causing them to flash on and off. This continues until the sixth flash of the light, when the "dog" becomes perfectly neutral. (The flasher, 7, can be made from the striking part of an old clock.)

A pointer connected to the rotator by a rod, may extend to the top of the dog's carcase. Numbers from 1 to 6 are placed on top of the dog, corresponding with the respective positions of the selector.

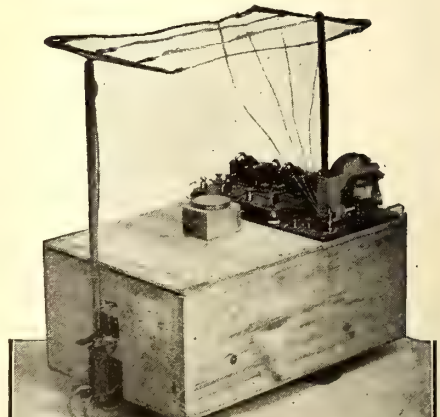
When the selective device is at point, 4, the pointer on top of the dog is at 4, etc. This enables the dog's master to determine exactly where the rotator is at any time, and to aid in the selecting.

By flashing the light rays on the selenium cell, one may watch the pointer and select any of the desired stops. If it is desired to have the dog to go to the right, the light rays must be flashed on the cell until the pointer is at index, 3. The rotator may be stopped at point 1, then at point 3, or 4, as desired.

When the dog is to be controlled wirelessly, the switch, 4, is turned to point, 2. This places the coherer in circuit with the polarized relay, 3.

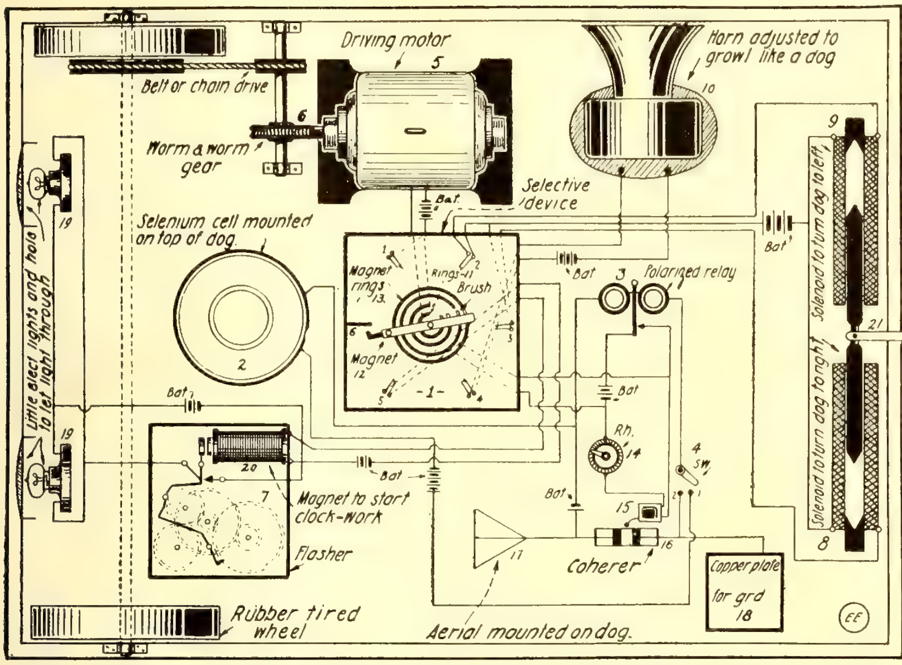
A small aerial is placed on top of the dog, and a copper plate on the side serves as a *capacity* ground. By using an ordinary radio sending set, selections may be readily made; each time the key of the sending outfit is depressed the selective device works in the same manner as with the use of the selenium cell and flashlight.

To make a real "dog-gone hound" out of this all-fired contraption one should procure some papier-maché and build up a



A "Mongrel" Wireless Pup which may Have his Works Encased in a Common Soap Box.

carcase on a wooden frame. The legs, head and tail can be easily formed in a rough manner of light sticks, well nailed and screwed. The legs do not move. Locomotion is effected through the two chain or belt-driven rubber-tired wheels on the front feet. The animal is steered about by the electro-magnetically controlled rear wheel, which should be painted and constructed to be as inconspicuous as possible. A crude electric dog is readily made from a soap-box and three wheels as shown in one of the illustrations herewith. The wooden frame of the dog may be covered with a mixture of shellac and paper, with a little care. Paper pulp works best for this purpose.

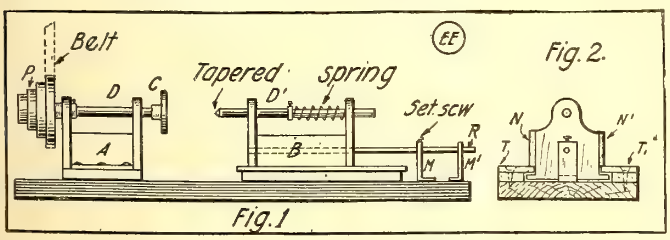


Wiring Diagram for Wireless "Hound," Showing Relation of Propelling Motor, Radio Apparatus, Selenium Cell, Steering Mechanism, Eye Lamps and Flasher and "Growl" Producer.

A SMALL WINDING LATHE.

Every experimenter wishes a small lathe to turn pulleys or wheels out of wood or to wind magnet coils. One that can be run from a small emery wheel motor or even a sewing machine, can be made from two old magneto frames such as used in telephones.

In Fig. 1, A is magneto frame with the armature removed; B is a second frame with rod R in place of armature and soldered or screwed to frame B. Rod R passes through two standards M M', with set screw in M to hold tail piece of B in position. The face plate C can be made by soldering a piece of brass to a ¼"-24 nut, which is usually the thread of the shaft D. Shaft D' has the large gear cut off and the shaft is tapered to a point. On this shaft is a spring with collar and set screw.



Simple Winding Lathe Constructed from Two Magneto Frames, Assuring the Builder of Having Good Bearings at Least.

Fig. 2 shows clearly the end view of B. TT are two pieces of flat iron to form a track. NN are two pieces of iron screwed on the sides of the magneto frame to form a slide.

When pulleys are turned the wood can be screwed to the face plate. The triple step pulley P was turned that way. When winding coils the core can sometimes be held by inserting a piece of rubber between face plate and core. The spring on shaft D tends to take up any lost motion.

Contributed by ARTHUR A. REEVE.

INVISIBLE PHOTOGRAPHS.

In time of war particularly, when certain information should be rigorously kept secret, even from subordinates in the same service, it may be useful for government officials, military commanders and others to have a method of keeping copies of plans, documents, photographs, etc., in their possession in such a manner that they are ordinarily invisible, but can be revealed by a simple process when required.

After trying numerous printing-papers and bleaching-baths, a writer in *Progresso Fotografico* has come to the conclusion that the least visible image is given by the thin sepia paper of commerce. It is exposed rapidly to direct light, developed in ordinary water, then treated with a 2-per cent. hyposulphite solution, and washed for a few minutes. The images obtained are not very rich in half-tones, but this is not of great importance for practical purposes. When the prints are placed in a solution containing, per liter, 10 grams of copper sulphate, 20 grams of potassium bromide, and 5 drops of hydrochloric acid, the image disappears instantly, and, after washing, one may dry the print, upon which nothing is visible. If the precaution is taken to plunge the print in a weak bath of potassium bromide, even exposure to light does not cause any reappearance of the image.

CELLULOID VARNISH.

For coating high frequency apparatus, varnishing loose coupler tubes and coils, mending broken celluloid articles, making enamel wire, or lacquering exposed metal parts of receiving apparatus, celluloid varnish is just the thing. It is easily made, and the great advantage of this varnish is that it has a very high insulating property, and when properly prepared, has a glossy finish, on coils for instance, that quite resembles glass. Another good point: it is moisture-proof, flexible and dries very quickly, an important factor. In short, it is a very useful and handy proparation in any laboratory or experimental workshop.

Formula.

1st.—Procure a quantity of film trimmings, which any obliging photographer will let you have.

2d.—Remove gelatine coating on film trimmings by washing them in hot water to which soap may be added.

3d.—When dry, dissolve films in the following solution:

Acetone, 2 oz.
Amyl Acetate, 2 oz.

Add the film trimmings until you have the right constituency to suit the work.

Contributed by
ARTHUR PELLETIER.

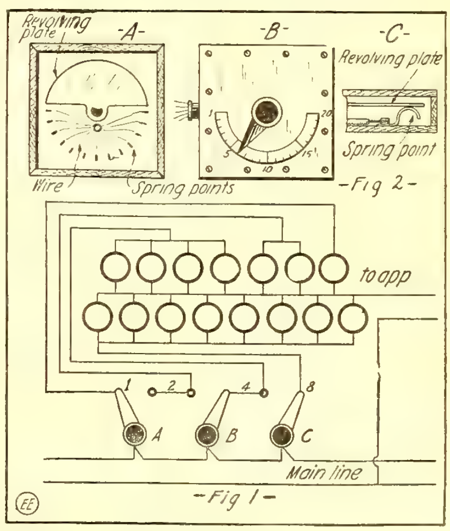
LAMP BANK SWITCHES.

A wiring diagram is shown at Fig. 1, by which the number of lamps connected in multiple in a lamp-bank is changed in uniform steps by means of a very simple switch-board. It may also be used to change the number of plates in a "fixed" condenser. By manipulating the switches A, B and C, the capacities, of which there are four, each in successive step twice the one before it (i. e., if the first is—one, the next—two, the third—four, and so on) can either be taken separately or added, so that fourteen capacities are obtained in steps equal to the first capacity value. The *points* on the switch-board are marked with their capacities as shown and thus it is a very simple matter to obtain the desired capacity.

(By connecting a single point switch, extra, to capacity No. 1, it can also be added to the sum total of all.)

Diagram No. 2, is a multi-point switch, by which the number of lamps or other apparatus, connected in multiple, is changed by simply turning a knurled knob. Each lamp is connected by one pole to a spring contact point, which is connected in succession to the others by the copper plate shown in diagram A, which is revolved over them by means of the knob.

It may be placed behind a panel as shown in diagram B, making it much neater. Diagram C, shows a spring contact point in detail. These should be mounted as nearly in the same plane as possible and should be of moderate strength only.

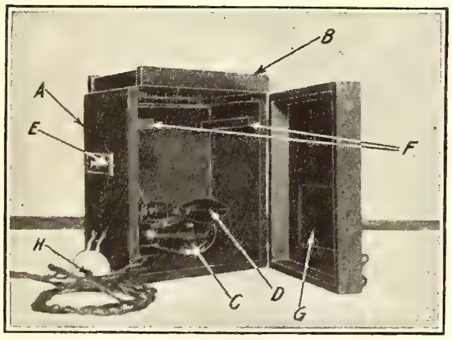


Effective Switching Arrangements for Lamp Banks, Permitting Any Number of Lamps to Be Connected in Parallel as Desired.

Contributed by JESSE O. HOWELL.

DARK ROOM LAMP AND PRINTING BOX.

Referring to the illustration herewith, A is a wooden box 8 by 7½ by 5¼ inches, outside dimensions; B is a printing frame (postcard size) screwed to the box over hole cut in box which corresponds in size to the opening in printing frame; C is a



An Amateur Dark-Room Lamp and Printing Cabinet of Small Cost. Contains Red and White Bulbs.

25-watt Tungsten lamp in socket; D is a 5-candlepower red bulb in a candelabra socket; E is a push switch off an automobile dash; F are blocks to hold a ground glass 4¾ by 6½ inches; G is the opening in front fitted with a yellow and a red glass, the latter being removable, while H is a cord and wall plug.

This outfit was made of material which I had around the house and gives the same results as a $7.50 outfit purchased from a dealer.

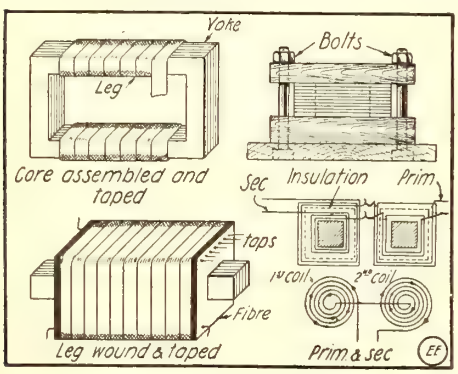
Contributed by A. E. WILSON.

A 30 VOLT LABORATORY STEP-DOWN TRANSFORMER.

This transformer operates on 60 cycle, 110 volts A.C. and gives from 3 to 30 volts in 3 volt steps. It is very suitable for use in a home laboratory.

The core is in the shape of a hollow rectangle, 6¼ inches by 4¼ inches outside dimensions, being composed of pieces of transformer iron, 1¼ inches by 5 inches and 1¼ inches by 3 inches, stacked in the usual way so as to make the core 1¼ inches thick when compressed. This will require the purchase of a piece of "stove pipe iron" 2 feet wide and 4½ feet long. After being stacked the legs of the core are taped with three layers of insulating tape and then the yoke pieces are pulled out, leaving the legs intact.

Four fiber heads are made 2¾ inches square, with a 1¼ inch square hole in the



Details and Hook-Up for Small Step-Down Transformer of Closed Core Type.

center. These are slipped over the ends of the legs.

The low voltage secondary is wound first. This consists of 240 turns of No. 14 D.C.C. wire, *120 turns on each leg*. This will require about two pounds of wire. Taps may be taken out as often as desired, depending upon the range of voltage wanted. In this case they were taken out every twenty-four turns, giving 3 volt steps. The taps are soldered and taped to the winding and the wire is run back over the winding to holes in the fiber heads. Each layer of wire should be shellacked.

Between the secondary and primary a layer of tape and several layers of shellacked paper are placed.

The primary (110 volt A.C. winding) should consist of 900 turns of No. 24 S.C.C. wire, 450 turns on each leg. This will require about one pound of wire. The wire should be wound very smoothly and evenly, and each layer should be separated by a layer of shellacked paper. Be sure to wind the two legs in the same direction.

Outside the last layer of wire on each leg place a layer of tape and shellac well.

The yoke pieces of the core should now be fitted into place. Place one piece between the laminations of the other leg and so on until all the spaces are filled. The windings should now be connected, the parts of each winding on the two legs being connected in series as shown in the drawing.

A good mounting for the transformer is shown in the drawing. The windings are left out for the sake of clearness. The taps from the secondary may either be connected to binding posts or some sort of switch, as the experimenter may elect.

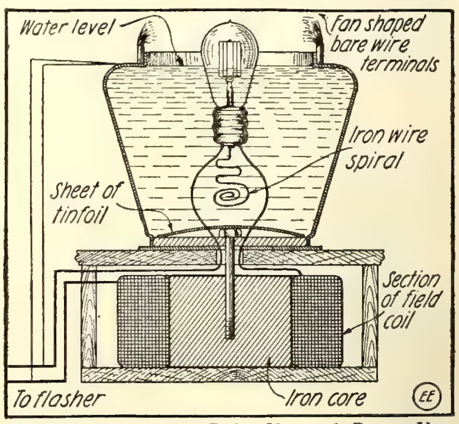
Contributed by ADRIAN SCHADE.

UNIQUE ELECTRICAL WINDOW ATTRACTION.

As everyone knows, the moving window attraction draws more of a crowd than any stationary display of goods, and if this attraction has the element of mystery in it the crowd will be larger. The *Electrical Review* gives the construction of one of these attractions, which is especially good for an electrical shop or booth. It consists of an opal arc-lamp globe practically full of water in which an incandescent lamp floats "tip up." At short intervals the lamp lights up brilliantly and at the same time disappears or ducks under the water in a very mysterious way. After a few seconds it again bobs up and its light practically fades out. This is repeated indefinitely. The only apparent, though misleading, explanation seems to lie in some wires with bared ends projecting over the edge of the globe, thus giving the idea that the action of the lamp was due to wireless or inductive influence.

The accompanying illustration will give the details so that anyone interested can construct one. A field coil from an old dismantled motor is placed in a box and within is put an iron core; a small iron pulley that happened to fit the coil was used for this one. An iron bolt is put through the box cover into the center of the core and the wires feeding the lamp run through the cover alongside the bolt. The lamp is connected in series with the coil; the wires are soldered to the lamp base and well protected by rubber tape. To seal the bottom of the globe use a rubber sheet with a layer of sealing compound filled in; an electric soldering iron is used to work the compound well around the edge and about the bolt head to make a water-tight seal. Fasten an iron wire with the lower part in a spiral form to the lamp base by a loop over the tape. This wire is of just the right weight to keep the lamp about half submerged when the current is off. Connect into the circuit a Thermo-blink flasher, which periodically cuts the current in the lamp and coil circuit down to a low value. As the current is restored to full value the coil is energized and the iron spiral with the attached lamp is pulled down toward the bolt head. A sheet of tinfoil over the latter prevents actual magnetic contact and sticking due to residual magnetism when the current is again cut down to its low value.

The cabinet on which the globe is placed and the wires really leading to the coil and lamp are covered by a cloth, leaving very conspicuous, however, the wires on the outside of the globe to the antenna-like ends. This little display will arouse no end of inquiries and, incidentally, will stim-

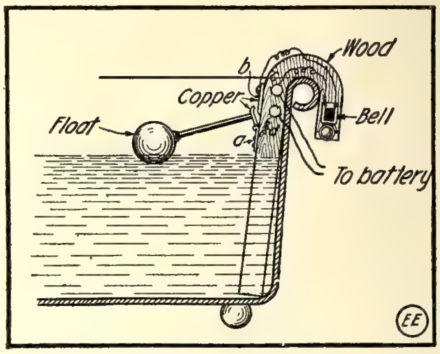


The Lighted Lamp Bobs Up and Down Very Mysteriously, Due to Action of the Electromagnet.

ulate the sales of all kinds of electrical goods, which, of course, is its prime object. Moreover, it is a novelty that will appeal to parlor entertainers and rising young Edisons who want to impress their doting parents with their marvelous genius.

A BATH TUB ALARM.

The hook at the top of the cane-shaped wooden strip is hung over the side of the bath tub and the water turned on. The float is made in such a manner that when the water rises as high as the float the water will lift the float up until contact A touches contact B, thereby closing the cir-



Removable Home-Made Electric Alarm for Bath Tubs. Rising Float Closes Bell Circuit.

cuit and ringing the bell. Of course a battery is connected to the two binding posts C and D. These posts may be placed in a convenient position on the wood strip.

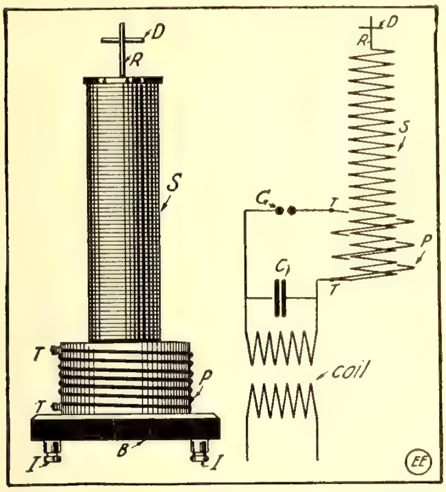
This piece of apparatus is intended to give an alarm when the water in the bath tub attains a certain height. For instance, suppose Mr. Jones wants to take a bath and also a shave. He puts the bath tub alarm in place and connects up the battery; then he turns on the water. He goes into another room and starts to shave. While he is shaving he hears the bell on the alarm ring, thereby notifying him that the tub is full. He can then turn the water off and keep the tub from overflowing.

Contributed by PHILIP MANDELBERG.

To polish woodwork: Apply several coats of varnish, rubbing down each coat with linseed oil and powdered pumice stone.

HIGH-FREQUENCY RESONATOR FOR SPARK COILS.

Procure a mailing tube S 9 inches long by 2 inches in diameter and wind with No. 34 wire leaving ½ inch space at the top and bottom. Next take a straight, short piece of No. 14 copper wire, filed to



An Oudin High Frequency Coil for Use on Small Spark Coils. Many Interesting Experiments Can Be Performed with This Apparatus That Open Up a New Field to the Amateur.

a point. The disc D is of thin aluminum and about 1 inch in diameter. In the center of this punch a hole so that the wire R may be pushed through it. A disc of thin fiber or heavy cardboard is glued to the top of the tube. A hole is punched in it so that the wire bearing the disc may be pushed ½ inch through it, that is down into the tube. One end of the No. 34 wire is soldered to the No. 14 wire. This completes the secondary.

The primary is of Empire paper or heavy cardboard 2½ inches wide and 3 inches in diameter. The primary winding P consists of eight turns of No. 14 stranded rubber-covered wire, the ends of which are fastened to two battery binding posts T T.

The primary is then glued to a small wooden base B. The bottom end of the secondary wire is soldered to the bottom primary post so that the windings are in the same direction. The last thing to do is to glue, *not nail or screw*, four standard porcelain insulators on the base.

The whole should be constructed without screw or nails, and if made carefully it will give remarkable results.

This resonator may be worked on any coil up to a 3-inch size, though it is rather too small for a ¼ k.w. transformer.

Before winding the tubes both should be boiled in paraffine.

Contributed by F. K. BILLAU.

PRODUCING CHLORINE ELECTRICALLY FOR LAUNDRIES.

A new field has been recently developed to some extent in the application of electricity to the washing of soiled clothes. This involves a process making use of chlorine, to be used as a substitute for the bleaching compounds commonly used for this purpose; and owing to the fact that this has been largely imported from abroad it has become quite out of reach for ordinary requirements.

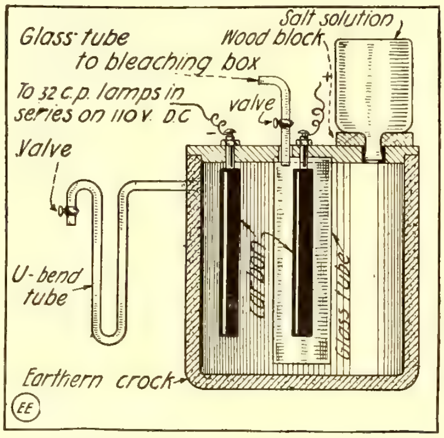
An easily made device for the electrolytic production of chlorine is described in the *Electrical World* by Mr. H. P. Hill. One of the smaller apparatus suitable for home use is described herewith.

Referring to the accompanying sketch the various parts of the device for electrolytically producing chlorine are indicated as follows:

In this type the apparatus is automatic and the current automatically cuts itself off when a supply of chlorine is made. The outfit can be adjusted to feed as little gas as required, the supply and discharge being regulated by the gas pressure in the generator. The bottle, usually 1 gal. in size, is filled with a saturated solution of salt water, and is inverted over the glass or earthenware crock, which a gasket makes air-tight. The glass tube shown, extends to within approximately 3 inches of the bottom of the crock.

The tube measures 3 inches in diameter and is sealed into the top so as to be gas-tight. On an iron rod is clamped the positive carbon, which is connected in series with a 32-cp. incandescent lamp. In the U-bend discharge pipe is a valve which is adjusted for the proper discharge. When the bottle is filled with the saturated salt solution, and the current is turned on, chlorine gas is formed inside the 3-inch glass tube. This gas drives the solution down into the tube until the circuit is interrupted at the bottom of the electrode. If the valve in the outlet pipe is closed or set for a small discharge, this gas will condense, and allow the solution to rise in the tube, re-establishing the circuit and so generating more chlorine. As the chlorine is discharged through the U-tube, new solution is allowed to feed down from the bottle, and the apparatus automatically makes the amount of chlorine within its capacity as required.

A glass tube can be extended through the cover into the large glass tube, thus obtain-



Simple Apparatus for the Electrical Production of Chlorine Gas to Be Used in the Laundry.

ing directly a supply of chlorine gas for bleaching purposes. This apparatus provides a ready means of securing chlorine solution or chlorine gas in small quantities at little expense. It has a wide field as a disinfectant or purifier, and is applicable to many and varied industrial uses.

(Caution. Chlorine Gas is highly poisonous and if taken into the lungs will cause dangerous congestion. It is advisable to place the apparatus in a well-ventilated shaft, carrying the fumes upwardly.—Ed.)

ELECTRICIANS' NON-CORROSIVE SOLDERING PASTE.

One lb. vaseline plus 5 fluid oz. saturated solution of zinc chloride sp. gr. 2.00, plus 1¼ oz. beeswax for a hardener to keep compound from running in warm weather. Melt all and stir well while cooling until emulsion sets. A little on the joint is all that is necessary to solder anything but aluminum.

A Speedy Brass Polish—1.65 oz. oxalic acid pulverized, plus 15.5 oz. Tripoli powder, mix thoroughly. To use, wet a piece of cloth with water and put a little of the polishing powder on, then apply to brass. As the brass tarnish is reduced, wipe off with a dry cloth to a bright luster. To preserve the finish, oil on a cloth rubbed over the polished surface, protects the brass from damp weather making the work lasting.

Contributed by JOHN A. COWING.

A REMARKABLE IMPROVEMENT IN ELECTRIC BELLS.

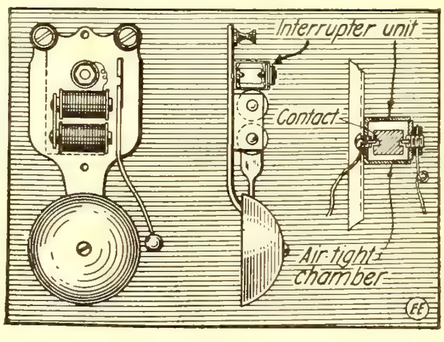
By W. Rademaker.

A new interrupter device, for bells and the like, which is practical and absolutely reliable under all conditions, has been patented lately. This interrupter represents a radical departure from all previous devices. The chief object in view with this invention is to do away with exposed contacts, thereby rendering the device positively water, rust, dust, ice, insect and foolproof. The contacts working in an hermetically sealed, air-tight chamber cannot oxydize or corrode. Therefore, an electric bell has been created which works without the principal source of trouble so frequently experienced with bells now—the breaker-post or contact screw.

The construction and working of the device is very simple. As will be seen in the accompanying illustration a cylindrical piece of metal has a hole drilled into it at each end. A thin sheet-silver bushing is inserted into each of these holes which rest freely upon two small silver points, *making contact with them by gravity*. When the current is closed the loose piece is caused, by the knock of the armature, to be jarred out of contact; thereby interrupting the current and allowing the armature to swing back to its original position by force of the supporting spring. By this time, however, the loose piece has come in contact again with the two points, repeating the action as long as electricity is flowing through the coils.

It may be of further interest to know that the consecutive blows of the armature cause the loose piece to revolve around the supporting points, whereby the contacts are always bound to be kept smooth and free from any possible impurities. The inventor has submitted the device to extremely severe tests, for instance, submerged in water, buried under ground or exposed to acid fumes for weeks, while the bells were continually ringing and are still good for long service to-day. This bell is self adjusting, no matter how many cells it is run on, for the stronger the knock given the cores by the armature, the more will the contacts—which rest upon each other by gravity—become separated, thus adjusting the bell automatically for any voltage.

Again, this bell uses the full magnetic field, because the current is only interrupted *after* the armature has actually hit the



A New Electric Bell Having Its Circuit Breaker Encased in an Air-Tight Tube to Prevent Corrosion of the Contacts. An Extra Rugged Design.

cores. With ordinary bells the armature really never enters the full magnetic field, which is, of course, strongest right near the core, for the current is almost immediately broken when the armature begins to move toward the cores.

This department will award the following monthly prizes: **First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.**

The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of **$3.00** is awarded; for the second best idea a **$2.00** prize, and for the third best a prize of **$1.00**. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

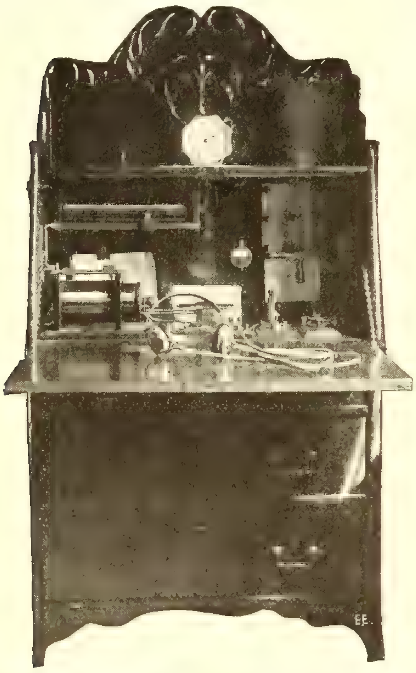
FIRST PRIZE, $3.00

A "DESK" RADIO SET.

Below is a photo of my radio receiving outfit mounted in a desk. It is not necessary to explain the different instruments which I have mounted in the desk as I think any one familiar with wireless will recognize them.

It is not the instruments as much as the manner of mounting them. A desk makes the set fool and dust proof.

I have entered this in your "How-to-Make-It" department, as I believe there are perhaps a few who wish to have a receiving outfit and one that will not require any extra space. The bottom drawers I use for magazines and books. My connections to ground and aerial are wired on the rear. When I have this desk closed, one would



In This Exceedingly Compact Radio Laboratory There Is Combined Neatness as Well as Freedom from Dust and Meddlesome Fingers.

hardly suppose that I have a receiving outfit installed therein. When I open it strangers are always quite surprised to see how neatly the instruments are arranged.

Contributed by JOHN F. CARLSON.

A COLD SOLDER.

Dissolve sulphate of copper in water until the water will dissolve no more. To this solution add bits of scrap zinc until all the copper sulphate goes down in a brown powder; wash two or three times by adding water, let it settle, then pour off the water and dry the powder. When dry, place in an earthenware vessel and add one-fourth as much mercury as powder. Add enough sulphuric acid to just make it into a thick paste, and then wash out the acid with hot water. If the paste is too hard add mercury and if too soft, strain out the excess mercury through chamois or cloth.

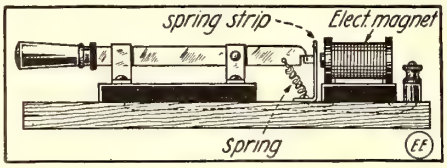
This solder will stand more heat than any other and only a small amount should be used. Before using, wet the pieces to be soldered with a solution of zinc chloride, and apply solder with the finger.

Contributed by H. V. QUINLAN.

SECOND PRIZE, $2.00

HOME-MADE OVERLOAD CIRCUIT BREAKER.

This circuit-breaker can be made at a very little cost. Obtain an electro-magnet to carry the required amount of current and mount it on a base. In front of it



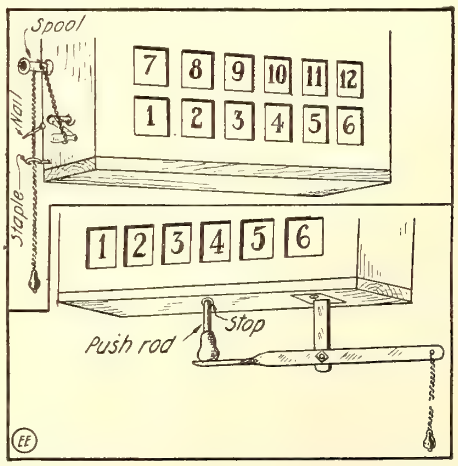
When the Line Current Passing thru the Electro-Magnet Becomes Excessive, the Spring Strip Is Attracted and the Switch Blade Opened.

mount a piece of spring steel as shown in sketch A. If an overload of current be sent through the magnet it will attract the steel spring and release the switch blade, thus opening the circuit. The same thing will happen on a short-circuit. An external resistance may be necessary to adjust the circuit-breaker to open at the right time.

Contributed by H. BOCK.

ANNUNCIATOR HINTS.

A cord, fastened to the reset handle of an annunciator, can be used where the instrument is too high to read. The illustration shows how this is done. A nail between two knots in the doubled string protects the handle against too severe a pull. The second arrangement is adapted to annunciators having a push rod to control the drops.



Clever Schemes for Rigging up a Chain Pull to Reset the "Drops" on Any Annunciator.

Contributed by R. M. MARTIN.

THIRD PRIZE, $1.00

A MOTORCYCLE HEADLIGHT WRINKLE.

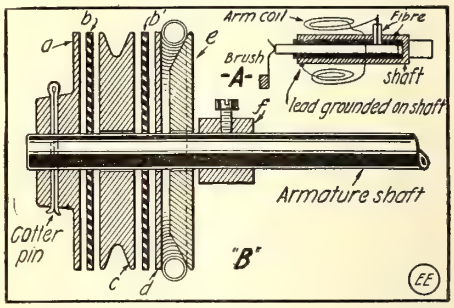
Below is a plan for a motorcycle headlight generator, which I am using successfully with a 21-cp. 12-volt nitrogen Tungsten lamp.

I rewound a four-bar telephone magneto armature with 200 turns of No. 21 D. C. C. for 12 volts. It could also be wound with 100 turns of No. 18 wire for 6 volts.

I replaced the original shaft with a longer one, so as to accommodate a governor pulley which keeps the voltage steady at all speeds, otherwise the lamp would be burned out at high speed.

The shaft may be made of a piece of ⅜-inch drill rod, and can be drilled in from one end with a ¼-inch drill to accommodate an insulated contact pin as in the original shaft shown in the diagram at "A."

The bearings may be made of brass or with a little skill may be made *ball bearing* by using small cups and cones. I used cups taken from a couple of old motorcycle pedals and made them a tight fit in brass plates. Iron or steel will not do as they carry magnetism. For cones, I used



An Automatic Governor Pulley to Prevent Excess Voltage on Motorcycle Dynamo Lamp.

bicycle cones which I annealed so as to drill out a sliding fit on the shaft.

The governor pulley is made up of a brass disc a, with a hub made of a brass nut soldered in the center on one side, and pinned to the end of the shaft with a cotter pin as shown at "B."

Next comes a 1/16-inch fiber disc b, the pulley c, another 1/16-inch fiber disc b', a flat brass disc d, about 1/16 inch, a ¼-inch fiber or brass disc e, beveled about 45 degrees on one side next to the pulley and a small shafting collar f, made of a brass connector such as used for connecting electrical wires.

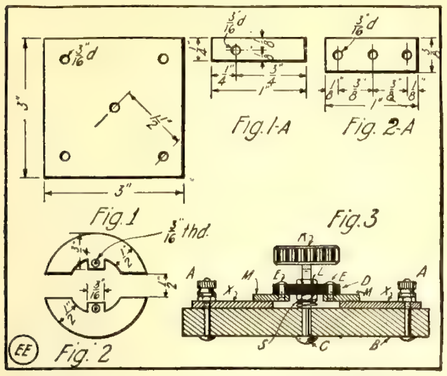
Finally you need a tightly coiled spring about 3 inches long x ⅜-inch diameter which goes on the beveled disc next to the pulley. This serves to force discs and pulley together like a clutch, which it really is. On the tightness of the spring depends the generator speed. When the governor reaches the speed for which it is set, the pressure of the spring tends to expand it, thereby causing the clutch to slip and in this way keeping the dynamo speed just right.

Contributed by

ARTHUR W. HUBERTY.

HOW TO MAKE A REVERSING SWITCH.

Most experimenters have need at times of a reversing switch, but the cost is usually prohibitive for a good one. The switch out-

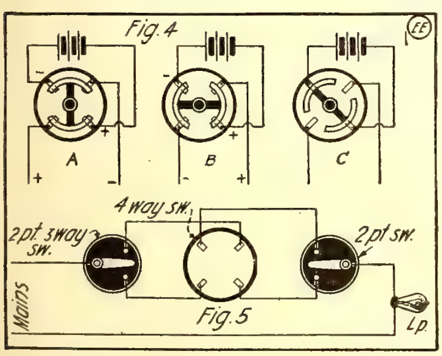


Details of Make-Up of Reversing or 4-Way Switch. Useful in Controlling Lamps or Motors.

lined herewith is comparatively simple, easy to make, and works on the rotary principle featured in all the newer instruments.

The base, Fig. 1, is made of hard rubber or thoroughly seasoned wood, ¼ inch in thickness and about 3 inches square. After the base is shaped, draw diagonal lines from the opposite corners. On each line 1½ inches from their intersection drill a 3/16-inch hole. Another 3/16-inch hole is drilled at the intersection. Now cut four pieces of sheet copper or brass as shown in Fig. 1-A. By means of binding posts inserted in the corner holes in the base and the holes in these strips, the strips which serve for contacts are secured to the base. They should lie diagonally across the base with the long ends toward the center.

The construction of the switch-blades is the next step. On a piece of sheet copper (or brass) lay off two concentric circles and two inches in diameter. The blades may then be cut out and shaped as indicated at Fig. 2. The ends of the blades, also the edges of the contacts, Fig. 1-A, should be beveled so as to work smoothly. The cross-arm to support the two blades should be of hard rubber 1 inch x ⅜ x ¼ inch drilled as shown in Fig. 2-A. Attach as shown in Fig. 3. M M are the blades, D the cross-arm and E E machine screws. Now insert a 3/16-inch machine screw through the base, screw a hexagon nut on it, place the cross-arm over this and screw another hexagon nut over it. The spring S makes far smoother action. Then attach a hard rubber knob for operating the switch and you are ready for business. Connections for this switch in a permanent magnet motor circuit are shown at Fig. 4. Fig. 5 shows how this useful switch can be used with two, 2-point switches, so that



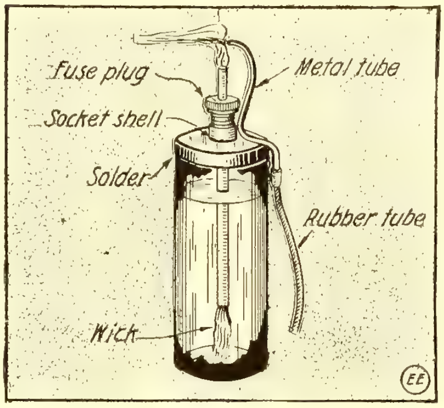
Wiring Hook-Ups for Using 4-Way Rotary Switch.

a lamp may be turned on or off from any one of three points.

Contributed by
AN EXPERIMENTER.

ANOTHER HOME-MADE BLOW TORCH.

Secure a tin can with an opening at the top 1 inch in diameter. Take an old socket of regular size and remove the threaded tube. Fit it in the opening, half way in, and solder it in firmly. Next get a blown brass plug fuse, break the mica and pass through a ⅜-inch brass tube and solder them together. Then pass a heavy wick through this tube. Obtain a narrow metal tube, bend to the shape shown in illustration, solder it to the can and part of the socket, attaching to the other end a narrow rubber tubing. Fill the can with alcohol and screw its cover on tight.



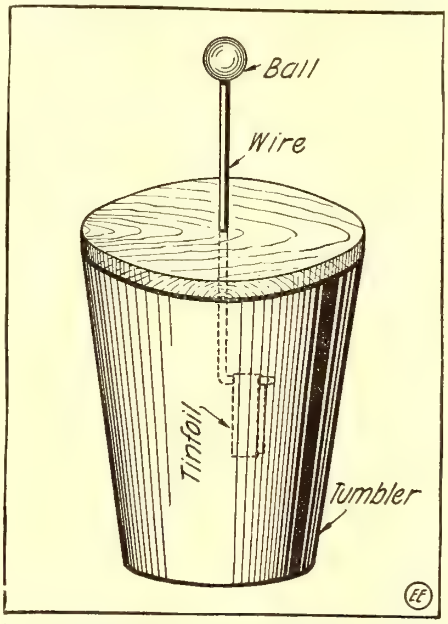
Efficient Style of Electricians' Blow Torch Made from Odd Parts.

Get a ⅜-inch brass plug to cover the brass tube, in order to prevent the alcohol from evaporating.

Contributed by D. JIMENEZ.

ELECTROSCOPE FROM ORDINARY TUMBLER.

For making experiments in static elec-



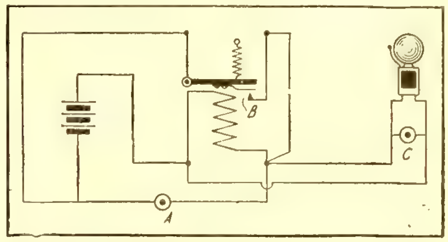
A Cheap Electroscope Constructed from a Glass Tumbler, Wire and Tinfoil.

tricity, electroscopes are often used. However, these are too expensive to buy for just a few experiments and thus the experiments are very often never made. Fig. 1, shows the construction of a simple and cheap electroscope which may be made in a few minutes' time. The jar may be a drinking glass or jelly tumbler. The top is a piece of tight-fitting, paraffined wood with a piece of coarse wire driven through the center of it. The lower end of the wire is bent in the form of a hook over which a piece of very thin tinfoil is placed. A lead ball is driven on the other end to prevent leakage.

Contributed by WALTER D. SHOLL.

RELAY CONTROLLED FIRE OR BURGLAR ALARM

When the fire alarm is rung by pressing the push or switching device, as at A, the armature of the relay will be attracted clos-



Clever Alarm Circuit in which Contact or Push A Closes Relay, Ringing Bell; Push C Opens Circuits.

ing the contact at B, causing the alarm to ring. At the same time it maintains a closed circuit through the relay as well as the bell, with the result that the armature holds the contact closed, and the bell rings continually.

Another push button C can be suitably placed and so connected that when pushed it will short-circuit the relay and allow the armature to open the circuit. This is quite an advantage over the mechanical reset when the relay must be placed so that it can be reached by the average man.

Contributed by N. M. FERRIS.

FOR THE AMATEUR CHEMIST.

The following is a method for preparing a substance that will detect an acid. In a pot put the outside leaves of cabbage. Cover them with water and boil for ten minutes. The water will have acquired a yellow tint. To test for an acid put some of this liquid in a test tube. Pour a few drops of the suspected substance in and shake the tube.

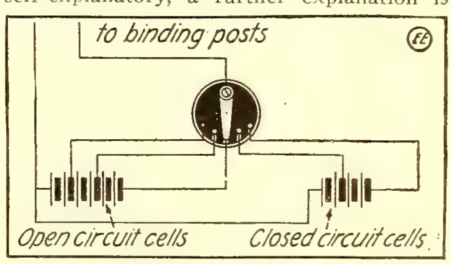
If the yellow color is destroyed the substance is an acid. To make the change more clear, some lime water can be added to the cabbage solution. This will intensify the color of it.

The lime water for the above experiment can be made very easily in the following way: Fill a bottle with water. Put in a few pieces of calcium carbide. After the carbide is slaked, filter the water through a piece of filter paper. This will be lime water.

Contributed by GEORGE E. MINCH.

SWITCH FOR OPEN AND CLOSED CIRCUIT BATTERIES.

The following is a description of a switch that has two uses: first it enables the experimenter to have at his disposal two different sets of cells such as storage or dry cells on one side and Daniel or Gordon cells on the other. As the diagram is self-explanatory, a further explanation is



Switching Scheme for Using Either Closed or Open Circuit Batteries.

unnecessary, except to state that the greater the number of points on the switch, the greater the amount of current that can be varied.

Contributed by
EDW. C. CONNELLY.

Experimental Chemistry

By Albert W. Wilsdon

Sixth Lesson

OXYGEN.

[Experimental]

IN the previous issue we went over the occurrence, modes of preparation, and properties of this gas. It is advisable that the reader go over all these details before taking up the experimental part, so that the operator may become familiar with the conditions surrounding the preparation of Oxygen.

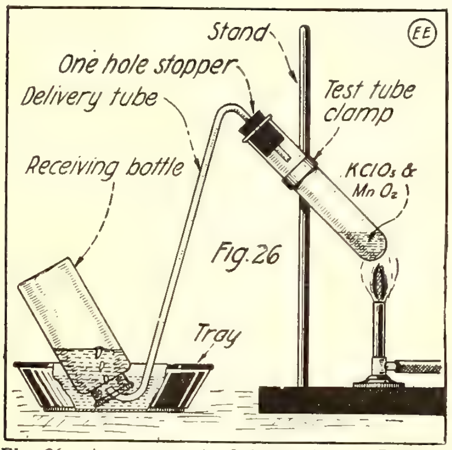


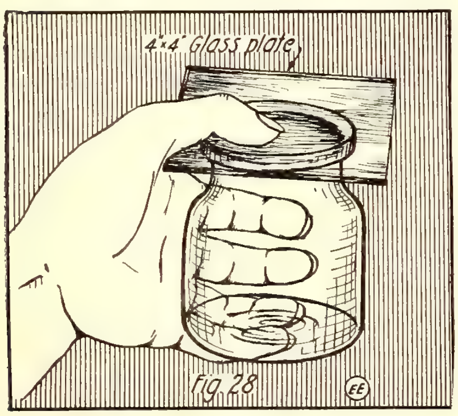
Fig. 26. Arrangement of Apparatus to Produce Oxygen by the Decomposition of Potassium Chlorate.

As stated in the last installment, the gas is usually made in the laboratory by the decomposition of Potassium Chlorate [$KClO_3$], by the displacement of water.

Oxygen may be prepared by the electrolysis of water with the apparatus described in the October issue; it is prepared with the apparatus mentioned by filling the glass chamber with water, to which a little Sulphuric Acid [H_2SO_4] has been added, to better conduct the electricity. The Oxygen is collected at the anode [or positive electrode] and Hydrogen is liberated from the cathode [or negative electrode]. Fig. No. 21 there given, shows how the apparatus is set up and needs no further description. Refer to Methods of Preparation, Method No. 3.

EXPERIMENT No. 16

Fill a large tray [about 10x12x4 inches],



The Bottle Which is to Trap the Oxygen, Fig. 26, is Filled with Water and a Plate of Glass Placed Tightly Over it Before Inverting.

or a large pan with water to about 3 inches deep. Bend a delivery tube as shown by Fig. 27. [Note: For method of bending glass tubing, see June, 1916, issue of THE ELECTRICAL EXPERIMENTER, under "Bending Glass Tubing."] Next set up the apparatus as shown in Fig. 26, by pushing the delivery tube through a one-hole rubber stopper which just fits a test tube. [Always remember when inserting glass tubing into a hole in a rubber stopper, to wet both the tube and the hole well, and push the tube in by twisting. Never try to insert a glass tube in a stopper without wetting both tube and stopper.]

Fill 4 eight-ounce, wide-mouth bottles full of water, as shown in Fig. 29, and slide a glass plate [4x4 inches] evenly over the mouth of the bottle, so that no air bubbles remain in the bottle, and when the glass plate is in this position, invert the bottle, grasping it as shown in Fig. 28, and place mouth down in the tray containing the water. When the bottle-full of water is UNDER the water in the tray, remove the glass plate. This will leave the bottle in an upright position, filled with water. Be sure that there are NO air bubbles in the bottle, and if any appear, repeat the operation, till all have disappeared.

Mix on separate papers, about 8 grams of Potassium Chlorate [$KClO_3$] and 5 grams of powdered Manganese Dioxide [also called Manganese Peroxide], [MnO_2]. Mix the two together by stirring thoroughly with a wooden splint or pencil. [It will not be out of place to mention here that Manganese Dioxide [MnO_2] is sometimes adulterated with other substances, which, when heated with Potassium Chlorate, may give rise to explosions. It is, therefore, advisable to test this compound before using, by mixing a little with some Potassium Chlorate [$KClO_3$], and heating in a test tube. If the decomposition takes place quietly, without explosions it may be used for the preparation of Oxygen. [If any slight explosions occur, reject the compound and obtain pure MnO_2. NEVER use this compound, if, after or during the tests, slight explosions occur; to do so, might result in injury.]

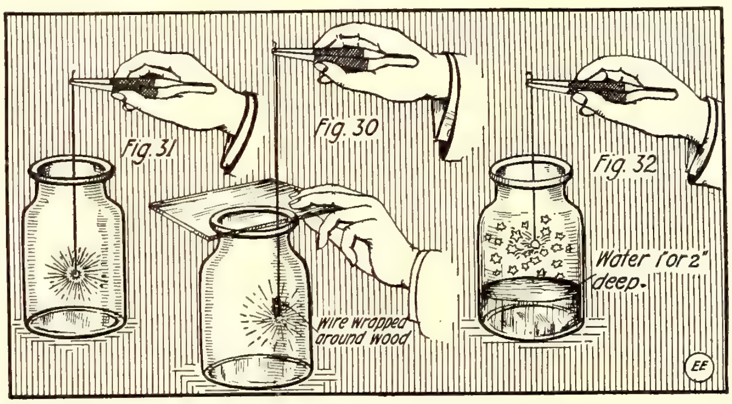
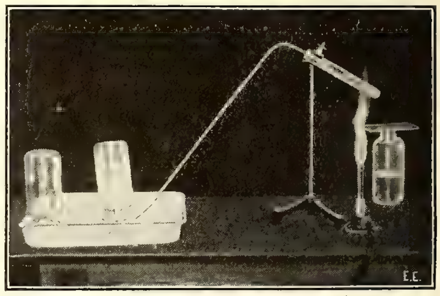


Fig. 30. Showing Glass Cover Slightly Displaced While Experimenting. Fig. 31. Burning Magnesium Ribbon in Oxygen. Fig. 32. Beautiful Effect Produced by Burning Iron Wire in Oxygen.

After both substances are thoroughly mixed in the proportions stated above, pour the mixture into the test tube, spreading it in the manner shown in Fig. 26; connect the apparatus as shown also by Fig. 26. After you have connected the apparatus, place the lower end of the tube under the bottle of water. [Do not lift the bottle from the water, but place the delivery tube under the bottle WHILE UNDER WATER.] This should be done after the first portions of the gas have passed from the tube [which are indicated by bubbles, and which is only heated air, and should be rejected]. After you have allowed this heated air to bubble through the water, place the delivery tube under the bottle, and observe and record any change which takes place, both in the test tube and the receiving bottle. When you have filled one bottle [the indication of which appears by the gas escaping around the sides of the bottle] REMOVE the flame from the test tube, and take the delivery tube FROM THE WATER, being careful not to upset the bottle of collected Oxygen.

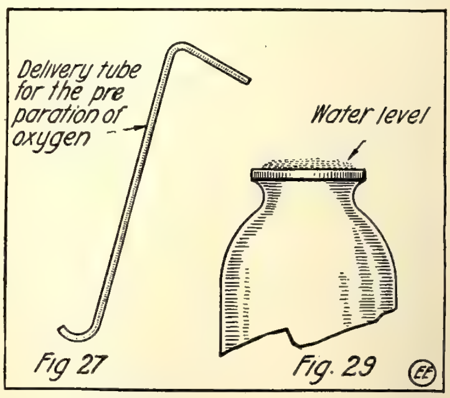


Photograph of Apparatus Shown in Fig. 26 Set Up in the Author's Laboratory.

[Note:—If the delivery tube is allowed to remain under the water after the gas has stopped generating (which is caused by removing the heat) the water will climb into the tube, due to a vacuum action, and if the cold water comes in contact with the hot test tube, it might crack it. This can be avoided by always remembering that when the heat is taken from the test tube ALWAYS REMOVE the delivery tube OUT of the water.]

Place another bottle [filled with water in the same manner as before], and place over the opening of the delivery tube. Prepare four [4] bottles of Oxygen.

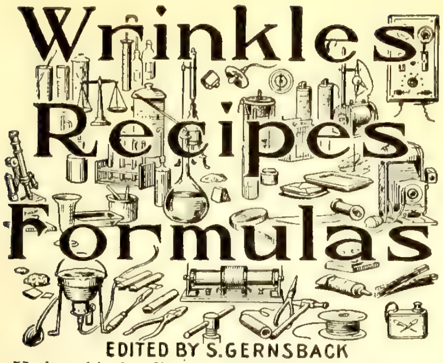
When you are ready to perform the following tests, slip one of the glass plates over the mouth of the bottle, in which the Oxygen has been collected. [Always perform this operation *while the bottle is under water*, otherwise the Oxygen collected will escape and air will be admitted.] Set the bottle right-side up [or with the mouth of the bottle up, still being covered with the glass plate].



Shape of Glass Delivery Tube and How Water Level Rises Above Top of Bottle.

[Note:—It is not necessary to remove each bottle from the water as it is filled; it can be left under water if a weight is

(*Continued on page 524*)



EDITED BY S. GERNSBACK

Under this heading we publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

EXPERIMENTER'S APHORISMS

In the following, we wish to give to the Experimenter some hints as to the use of the different ingredients and how to work them:

(1) Always bear in mind that exact working of a formula requires ACCURACY, CLEANLINESS, PATIENCE, and SKILL.

(2) Know what you are about, before you start to experiment.

(3) "THE HISTORY OF FAILURES IS THE HISTORY OF SUCCESS" goes an old adage, and it applies well to the experimenter.

(4) Many times impure, wrong or deteriorated raw materials, spell FAILURE instead of SUCCESS.

(5) A great many of the chemicals and ingredients required, cannot be obtained from drug stores; buy them at a reputable supply house.

(6) BEFORE CONDEMNING A FORMULA, be sure the fault does not lie with the manner of handling it, or the purity of the ingredients.

(7) Be sure to mix the materials comprising a certain formula in the proper sequence.

(8) When starting to prepare a mixture, especially one containing liquids, ask yourself: "IS THE SPECIFIC GRAVITY CORRECT, AS INDICATED BY A HYDROMETER? IS THE TEMPERATURE RIGHT? IS THE QUANTITY OR WEIGHT RIGHT?

(9) Acids and water, when mixed, should be manipulated in the proper manner, i. e., THE ACID SHOULD BE POURED INTO THE WATER, and not vice versa, as the solution is liable to be forcibly ejected from the containing vessel and into the mixer's face.

(10) For any kind of SYSTEMATIC WORK, a floating THERMOMETER and HYDROMETER, as well as measuring glasses and scales, should always be provided, as GUESSWORK is EXPENSIVE, and SOMETIMES FATAL.

(11) Put labels on ALL bottles, boxes and packages with FULL INSCRIPTION as to their contents, it will avoid troubles and mistakes.

(12) Remember that a beginner cannot expect to make articles AT FIRST, which will compare with regular manufactured products. S.G

FORMULA FOR DISINFECTANT.

1 *oz.*	6 *drams*	*Guaiacol*
1 *oz.*	3 "	*Eucalyptol*
	6 "	*Menthol*
1 oz.		*Carbolic Acid*
	3 "	*Thymol*
	½ "	*Oil Clove*

Enough Alcohol to make 2 lbs.
To be sprayed about with water.

TO PRINT A PICTURE FROM THE PRINT ITSELF.

—The page or picture is soaked in a solution, first of caustic potash and then of tartaric acid. This produces a perfect diffusion of crystals of bitartarate of potassa through the texture of the unprinted part of the paper. As this salt resists oil, the ink roller may now be passed over the surface without transferring any part of its contents except to the printed part.

Magic Paper.—*Take lard oil, or sweet oil, mixed to the consistence of cream, with either of the following paints, the color of which is desired: Prussian blue, lampblack, Venetian red, or chrome green, either of which should be rubbed with a knife on a plate or stone until smooth. Use rather thin but firm paper; put on with a sponge, and wipe off as dry as convenient; then lay them between uncolored paper, or between newspapers, and press by laying books or some other flat substance upon them until the surplus oil is absorbed, when it is ready for use.*

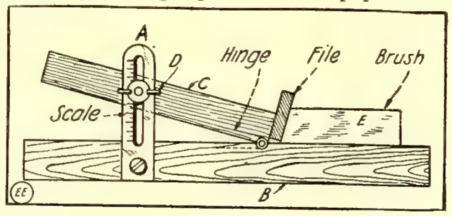
Directions.—For taking off patterns of embroidery place a piece of thin paper over the embroidery to prevent soiling; then lay on the magic paper, and put on the cloth you wish to take the copy on, to embroider; pin fast, and rub over with a spoon handle; and every part of the raised figure will show upon the plain cloth. To take impressions of leaves on paper, place the leaf between two sheets of this paper, and rub over it hard, then take the leaf out and place it between two sheets of white paper; rub again, and you will have a beautiful impression of both sides of the leaf or flower.

DEVICE FOR SHAPING NEW BRUSHES FOR COMMUTATORS

The drawing shows a simple device for shaping new brushes for commutators of motors and dynamos. The strip A is fastened to the board B, while piece C is hinged to B. D is a wing nut and screw, which can be clamped to keep the piece C at its adjusted angle.

The old brush is laid on as shown at E, and C adjusted to the nearest angle. The file is placed on B. The new brush is held against B bearing against the file. This device roughs out the brush to approximately the right shape. The clamp strip A may be graduated to correspond with different angles.

After beveling off the brushes in this way to approximately the correct angle, they are placed in the brush holders and shaped to fit the commutator curve accurately by pulling a piece of sand-paper back



A Time-saving Carbon Brush Facing Device.

and forth under the brush. Hold down on both ends of the sand-paper—not up.

Contributed by C. ANDERSON.

EXPERIMENTS OFF THE BEATEN TRACK.

The following experiments are not only interesting, but have the additional charm of novelty, being of a kind that one does not usually come across in the text-books.

For the first there will be required a bobbin about four inches in length with a central hole an inch or more in diameter and having a few hundred turns of double cotton covered wire wound on it. This should be fastened end-up on a sheet of mirror glass and the ends of the wire connected with a source of rapidly alternating current.

Into the hollow core drop a few flakes of black magnetic oxide of iron, prepared as described below. At first no effect will be observed; but let a soft iron bar, or what is better, a bundle of soft iron wire, be inserted for a moment and withdraw; the particles of oxide will at once become endowed with extraordinary activity. The flakes that were formerly at rest will be seen to be dancing vigorously under the influence of the alternating current, the movement being both side to side and up and down. The probable explanation is that the particles of oxide become permanently magnetized during the brief time that the iron core is within the bobbin. The polarity thus induced causes the particles—which, it will be remembered, are in the form of flakes—to present opposite ends to the middle of the bobbin alternately under the influence of the alternating current. The lateral movement is attributed to the mutual attraction and repulsion between neighboring particles.

To make the oxide in the form required for the experiment, cut a piece of tinned iron from a can and leave it in an open fire until the surface is covered with black oxide. If carefully removed and allowed to cool, a little gentle bending between the fingers will detach the oxide in the form of irregular flakes.

The next experiment is even less exacting in the matter of apparatus, only a little finely powdered graphite or bronze powder being required. The current, which may be drawn from the house supply, should be about 200 volts D.C. Two wires should be carried from the lighting circuit, provided with insulating handles for convenience, and having a high-resistance voltmeter in series. Place a small heap of perfectly dry printers' bronze powder on a sheet of paper, and insert the ends of the wires in opposite sides of the heap. The voltmeter will not at first register the passage of a current; but upon gradually bringing the wires closer together the needle is ultimately deflected. After this they may again be separated without stopping the flow of current. Moreover, if the wires are brought fairly close together they may be slowly separated, not only from each other, but from the powder, without interrupting the flow of current. Upon inspection it will be found that the wires are connected either with each other, or with the powder, by an exceedingly fine thread of bronze. With care it is possible to obtain a separation of an inch or so. No doubt the chain is produced by a welding together of the minute particles composing it under the influence of heat, generated by the current. If graphite powder is used, several threads can be drawn simultaneously.

The third experiment to be described is of a very simple character, and only requires a carbon filament lamp and a perfectly dry, warm cloth. Immediately after switching off the current, that is while the lamp is still hot, it should be removed and rubbed briskly with the cloth. The outer surface becomes charged by friction and the inner surface by induction, sometimes sufficiently to attract the filament to the side and hold it there. At the same time a luminous glow is observed in a dark room.

Contributed by H. J. GRAY.

WOOD POLISHES.

A polish for burnished wood surfaces may be made of the following: *Wood Pulp*, 40 parts; *Hydrochloric Acid*, 44 parts; *Chloride of Lime*, 15½ parts; *Turpentine*, ½ part. Mix in the form of a paste and smear over the surface, allowing it to remain a short time and remove it by quick strokes of a soft brush or leather, thoroughly cleaning the surface. Rub gently to a polish with a fresh piece of cloth or chamois.

For very highly polished surfaces the following may be used: Dissolve 5 parts *Potassium Carbonate* in 300 parts *Water;* **dissolve in this 500 parts shaved-up *Beeswax* by boiling until the wax is partially saponified, replacing the water evaporated. Remove from the fire and stir until cold; add *Oil of Turpentine*, 800 parts, stir constantly until a smooth emulsion results, then add 800 parts of *Distilled Water*, continuing the stirring. Wash, rinse and dry the surface to be polished. Apply the paste as uniformly and as thinly as possible; rub off with a soft woolen cloth.**

I KNOW what you boy-friends of mine like! That's why I've thought out this new and big idea that will give you more fun than you ever dreamed of before with your Erector, Brik-tor and Erector Electrical Sets.

What is the "Gilbert Institute of Erector Engineering?"

You must write for my free, handsome book which contains the whole interesting story. However, the following will give you an idea as to what a big thing it is:—

You know the great yearly prize contests that I have held—giving away Automobiles, Motor-cycles, Canoes and hundreds of other valuable gifts for the best models built by boys.

Now—I am going to continue to give these prizes, and in addition—all boys who send me photographs or drawings of acceptable models of *any* Gilbert Toys, will be given free enrollment in the "Gilbert Institute of Erector Engineering."

Just think what this means to you!

You will become a member of the Greatest Toy-Engineering university of the world. You will have an opportunity to win prizes, honors, degrees and diplomas that you will be proud of all your life. And you will have loads of fun while you are doing it.

Listen! The "Gilbert Institute of Erector Engineering" will confer on boys Three Degrees as follows:

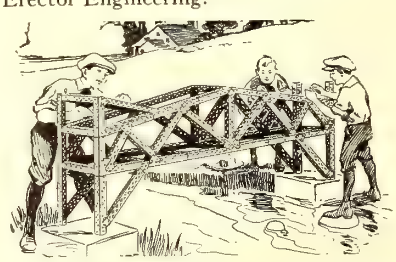
The First Degree— **"Erector Engineer"**

The Second Degree— **"Erector Expert Engineer"**

The Third Degree— **"Erector Master Engineer"**

The Valuable Awards Given To Boys Who Win the Third Degree

(1) A handsome diploma ready for framing, conferring upon you the Degree and Title of "Erector Master Engineer."
(2) A beautiful, gold "E. M. E." Fraternity Pin which you can wear on your coat so that everyone will know of your ability.
(3) A salaried position with The A. C. Gilbert Co., during the holiday season, following your winning the "Third Degree." This position is with our Demonstration Corps, and will pay you a salary of $10.00 per week for three weeks with an extra commission of 1% on total sales.
(4) A recommendation, signed by Mr. A. C. Gilbert, for a position with any firm, indicating that you are the type of boy who is sure to make good, and who has won highest standing in the "Gilbert Institute of Erector Engineering."



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(1) Send me a photograph or drawing of an acceptable Erector model with or without motor attachment.
(2) Send me a photograph or drawing of ar ceptable Brik-tor model.
(3) Send me a photograph showing that know how to put together a motor parts of which are included in the Er Electrical Set.

Get busy right now! Do one of the a things immediately, and I will make you a r ber of the "Gilbert Institute of Erector I neering," send you the handsome "Erector gineer" Diploma, and a Certificate telling

FOR LIVE WIRE

EREC

"The Toy Lik

Hello, Boys! Do *you* own a set of Ere If you don't, you have no idea what a l fun you are missing.

Erector is the toy for the "live-wire" boy—the boy who has imagination and ability. With a set of Erector, he can build models of the world-famous engineering feats like the Brooklyn Bridge, the Panama Canal, the great skyscrapers of New York City, the Eiffel Tower, and hundreds of other things such as Machinery, Automobiles, Aeroplanes, Battleships, Engines, Printing Presses, Steam Shovels, Farm Implements, etc., etc.

Big Exclusive Erector Advantage

1—The only actual structural steel toy
2—The only construction toy with inter locking edged girders for building squar columns.
3—Most parts for building largest an strongest models.
4—Big, reinforced steel wheels, grove and hubbed for every engineering purpos

Engineering
BOYS
REAL ENGINEERING"

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to do in order to secure the next highest e—"Erector Expert Engineer." the complete story of the "Gilbert Insti- f Erec or Engineering"! out the coupon which appears at lower hand corner of this page; mail it back to nd I will send you your free copy of my ful book which tells all about it, as well as luable rewards.

President.
The A. C. Gilbert Co., New Haven, Conn.

S—GILBERT'S
TOR
ctural Steel"

urdy electric motor that will lift 200 when properly geared, comes free with most sets.

6—Three big illustrated Manuals showing over 500 models. Of course you can build thousands of others as you acquire proficiency.

7—Free membership in the "Gilbert Institute of Erector Engineering" with handsome diplomas and other awards, including the $5000 Prize Contest for Boys.

The Famous "FOUR"

Contains every essential engineering part for building thousands of models. Has big girders, large and small wheels, shafting, corner plates, angle irons, pinions, pulleys, gears, nuts and bolts and the great electric motor. Also included is our beautifully illustrated Manual No. 7 showing how to build all kinds of models. Packed in a handsome, hardwood cabinet. All for only $5.00, Price in Canada—$7.50.

Dealers everywhere are glad to show you the new Erector Sets—$1.00 to $25.00.

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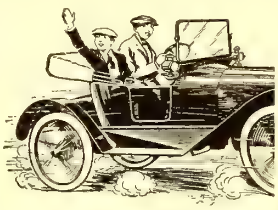
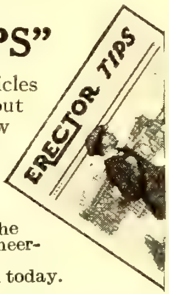


Go after these prizes, boys! Gardner Grote—a St. Louis boy—won the first prize of the automobile last year and the Mayor of St. Louis presented it to him. Will you bring this honor to *your* city and yourself this year?

Send photograph or drawing of your model along with properly filled out entry blank. One of these entry blanks is included in each copy of my great magazine for boys—

"ERECTOR TIPS"



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"The Toy That Completes Construction Toys"

Just think what Brik-tor means to every boy who now owns a construction toy set.

It will enable you to complete the framework models that you build with Erector or any other construction toy — and to make finished houses, churches, factories, bridges, tunnels, brick piers, tile walks, and various other models with steel bricks in brilliant color combinations.

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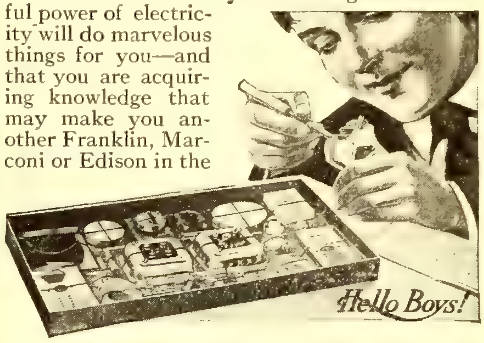

Gilbert's Erector Electrical Set and Elementary Course in Electricity

Once you see it, your hands will fairly twitch to get hold of it. You will be able to build your own motor that will operate both backward and forward, and regulate its speed at will, so that your Erector models, mechanical toys, electric trains, etc., can be operated perfectly.

And the great, big, beautifully illustrated book, which comes with every set, will show you how to do more than a hundred intensely in eresting electrical experiments—how to build your motor, make magnets, wire door bells, and electric lights, construct switches, etc.

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Name ....

Street ....

City.......................State.........

ERECTOR To Engineering FOR BOYS

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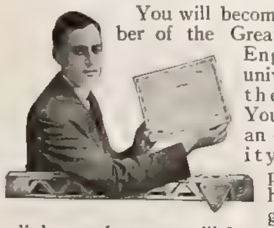

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Gilbert President.

The A. C. Gilbert Co., New Haven, Conn

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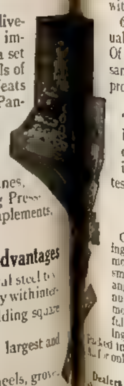

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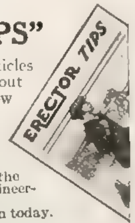

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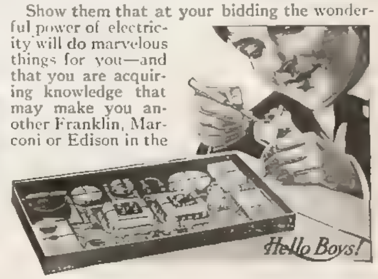

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WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

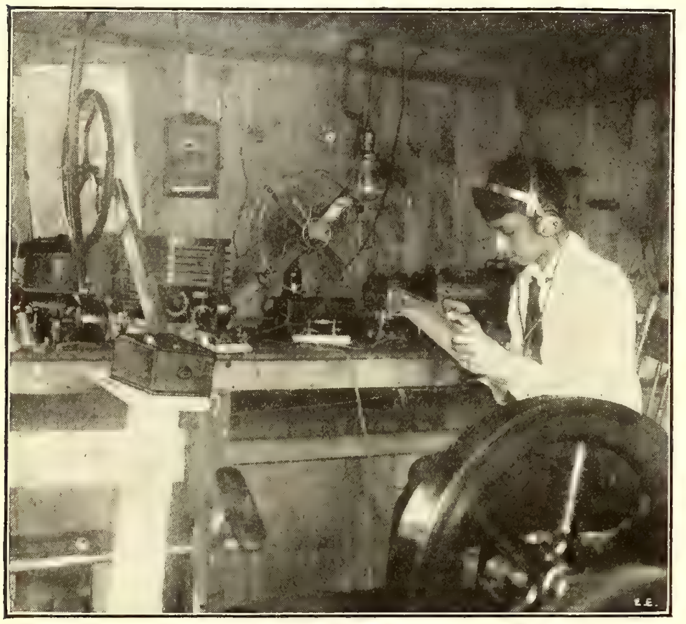
AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

EXPERIMENTAL LABORATORY OF LIVINGSTON WELCH.

An excellent experimental electrical and radio laboratory is owned by Mr. Welch. He is seen sitting among his various elec-



The Excellent Electrical and Radio Laboratory of Livingston Welch.

trical apparatus and we'll bet dollars to doughnuts that there are 90 per cent of our young readers who would like to change places with him. Mr. Welch writes us as follows in reference to his radio activities:

In my radio transmitter I use a one-inch spark coil, 2 high tension condensers, a spark gap, ½ K.W. helix and a wave meter. I have been heard at a distance of 15 miles. I have two pairs of Brandes' receivers, one 2,000 ohms and the other 3,200 ohms. I use a loose coupler, a silicon detector, loading coil, together with a variable and a fixed condenser.

The aerial is 40 feet high at one end and 30 feet high at the other. It is composed of two strands of copper wire, each 150 feet long. With this set I have obtained very good results, having heard NAA, WSL, WUL, etc.

LIVINGSTON WELCH.

Port Washington, L.I., N.Y.

AMATEUR RADIO SUCCESSFUL IN CAMP.

After one complete year of thorough searching, the National Volunteer Emergency Service, through its operators—Lieutenant Freeman and Private Schwartz—decided that the best outfit for camp requirements was that supplied by the Electro Importing Company. This set is one of their Trans-Atlantic outfits and has served us almost as far as the name implies.

$10,000 CASH PRIZE—IF YOU ARE A "WHALEBONE" EXPERT.

Ten thousand dollars cash will be paid to anyone for the discovery and assignment of all rights in any new practical process for the commercial, profitable and general utilization of *whalebone*, announces Mr. Aaron Sapiro of First National Bank Building, San Francisco, Cal. It has heretofore been used principally in the manufacture of corsets and whips. Such a process, if offered, must be satisfactory, in their exclusive discretion and in all commercial and scientific respects, to the parties authorizing this offer. The offer expires January 1, 1917.

The receiving set consists of a large, double-slide tuner, a loading coil with a very high inductance, a rotary variable condenser of the Gernsback type, and two detectors, a crystaline and a Radioson. The stopping condenser has three different capacities and is manipulated by means of a rubber knob switch. A small switch permits the operators to change from the crystal detector to the Radioson.

The 'phones are also E. I. Co., make and are wound to 2,000 ohms.

For sending, one of their one-inch spark coils is utilized with two three-volt batteries and constant communication with ships in the harbor is carried on.

The set is extremely compact and handsome, and with the aid of a four-wire aerial seventy-five feet long, Key West, Colon, Arlington and other stations are readily heard.

Readers of THE ELECTRICAL EXPERIMENTER are invited to visit the camp at Dyker Beach, Brooklyn, N.Y., and "listen in."

Radio Station at Dyker Beach, N. Y., Operated by Experts of the National Volunteer Emergency Service.

ADOLPH SCHWARTZ,
Call 2 ASK.

Dyker Beach, Brooklyn, N.Y.

KARL DUERK'S RADIO STATION.

As I am always interested in pictures of radio sets I take this occasion to send a picture and description of my set. It is of my own design and construction and the results have quite exceeded my expectations.

My receiving set is of the cabinet type and contains a loose coupler, two galena and a silicon detector, a large single layer loading coil, a fixed condenser and a variable fixed condenser and Murdock special phones.

My transmitter is composed of a helix, an adjustable high tension condenser, spark gap, 1½" coil and the transmitting key.

I use an aerial 75 feet long and 42 feet high, composed of four copper-clad wires

Karl Duerk Busy at His Radio Instruments.

and a lead in of No. 6 copper wire run to the lightning switch.

With this receiving set NAA can be heard with the receivers off—also 8 NS, 8 AEV and about a dozen amateur and several commercial stations.

KARL DUERK.

Defiance, Ohio.

GIRL ASCENDS 426-FOOT RADIO MAST.

Certain repairs had to be made to the top of one of the steel towers of the Marconi wireless station near New Brunswick, N.J., recently, and a workman was assigned to go to the summit, 426 feet above the ground, in a swing operated by ropes and pulleys.

"I'm going up with him!" announced Miss Nellie Albee, daughter of the manager, M. B. Albee.

Her father protested, but Miss Albee said "You took mother up 395 feet Monday afternoon, and I'm going to beat her record."

So the girl took her place in the little bos'n's chair alongside the mechanic and was hoisted to the very top of the tower, where she sat while he did his work.

JOHN HAYS HAMMOND TESTING WIRELESS TORPEDO

Sixteen men from the Coast Artillery are assisting John Hays Hammond, Jr., in his experiments with a wireless-controlled torpedo at Gloucester, Mass.

Mr. Hammond will demonstrate his invention before a joint Army and Navy board this fall, as demanded by Congress. A motor boat capable of thirty miles an hour will be controlled by wireless from an aeroplane.

CHARLES HILL'S RADIO EQUIPMENT.

This photo of my wireless station shows the loose coupled tuner of 2,000 meters, 2,000 ohm 'phones, 1,000 meter loading coil, fixed condenser and galena detector. I have

Charles Hill and His Radio Apparatus with Which He Hears Many Long Distance Stations.

just recently enclosed my receiving set in the cabinet. The two switches to the left of cabinet are the primary switches; below there can be seen a 400 meter dead-end switch.

The secondary switch is at the right of the cabinet, below is the secondary slider. The loading coil switch is between the secondary and primary switches. The galena detector is mounted on a small door which can be closed when the detector is adjusted. For sending, I am temporarily using a relay which I transformed into a high-tone buzzer until I complete a 1/4 K.W. transformer which I now have started to build.

My aerial consists of two stranded copper wires, 4 feet apart, 150 feet long and 50 feet high.

I have had very good results with this station. Some of the principal stations I hear are NAA, NAR and WCC., et cetera.

CHARLES HILL.

Ligonier, Ind.

NAVAL RADIO SERVICE NOW "NAVAL COMMUNICATION SERVICE."

Hereafter, the Naval Radio Service will be known as the *Naval Communication Service*. Charges on all traffic exchanged between other systems (radio, telegraph and cable) and radio stations (ship and shore) operated by the Navy will be accounted for by the Naval Communication Service.

In addition to his other duties, the Director Naval Communications will perform the duties formerly assigned to the Superintendent Naval Radio Service.

Correspondence relating to the Naval Communication Service should be addressed to Director Naval Communications, Radio, Va. Remittances should be made payable to Naval Communication Service. If used, money orders should be drawn on Postmaster, Washington, D.C. Commander D. W. Todd, U.S.N., has been transferred from the command of the U.S.S. *Dixie* to Director Naval Communications. Captain W. H. G. Bullard, U.S.N., formerly superintendent at Radio, Va., has been placed in command of the U.S.S. *Arkansas*.

Hongkong, China, has a wireless station with a radius of from 500 to 700 miles in daytime and more than 1,300 miles at night.

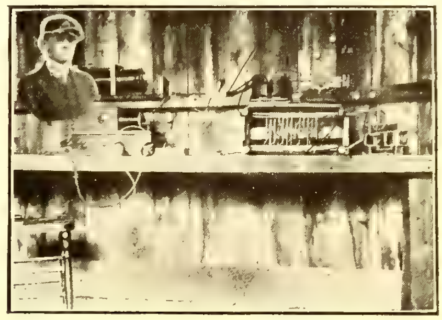
RADIO APPARATUS OF GEORGE R. HAMMOND.

The receiving set of my radio station is as follows: 3,000 meter loose coupler with fixed condenser, galena detector and Superior 'phones. I also use a compact receiving set, consisting of a loose coupler, loading coil, two condensers and galena detector all mounted in and on a cabinet.

The transmitting outfit comprises 1/4 K.W. Blitzen transformer, a Sayville rotary gap, hinge type oscillation transformer, glass plate condenser and key.

These instruments, in connection with my aerial, which is at present 40 feet high and 90 feet long, have enabled me to do excellent work. I am able to transmit 30 miles in any weather and on good nights can cover between 50 and 60 miles. At times last winter I have been heard at the Iowa State College Station at Iowa City, which is a distance of about 100 miles.

My receiving range includes 9ZS, 9BC, 9YA, 9YI, 9QF, 9IN, 9KD, and at times have heard Key West, Fla. I am a member of the *United Radio Relay League* and have



George Hammond and His Ambitious Looking Radio Laboratory.

applied for a government amateur license. My call at present is GRH.

GEORGE R. HAMMOND.

Oelwein, Iowa.

Amateur News

The South Jersey Radio Association.

On June 12, 1916, a number of the Amateur Operators of south Jersey headed by Mr. C. Walde Bachelor, Wm. G. Phillips, Harry D. Densham, and Geo. E. Haldeman, met and organized the South Jersey Radio Association, with headquarters at Collingswood, New Jersey, the following officers being elected for a term of one year: President, C. Waldo Bachelor; vice-president, George E. Haldeman; Treasurer, Wm. G. Phillips; Secretary, Harry W. Densham.

At the present time the organization is well under way and is affiliating with all the smaller associations throughout the state with the object of forming a strong body to combat any detrimental legislation that may come up and to form an efficient relay service throughout the state.

All clubs wishing to become members of the South Jersey Radio Association should communicate with Harry W. Densham, secretary, Collinswood, N.J.

The Wireless Association of Pennsylvania.

The Wireless Association of Pennsylvania held its regular meeting recently. The past year was one of the most successful for the Association. The success of the organization is due to the excellent work of the Technical Committee and the interest displayed by the members.

The work of the Committee in the past season consisted mostly in the study of the "Vacuum Bulb" as a detector and instructing the members in the requirements for securing Commercial Operators' Licenses.

The majority of the members possess sets which are noted for their high efficiency and long distance work. The Association has the advantage of having as members, men of high standing in the field of Radio activities, and a large number of Commercial operators and wide-awake amateurs.

At the last meeting of the Board of Directors plans were formulated for the work of the coming year. An increased membership is decided upon in order to repay the Technical Committee for its extensive research.

The Association has resumed work with lots of vim. The Secretary would favor any information or correspondence from similar organizations. Robert E. Patchel, Secretary, 532 S. Fifteenth St., Phila., Pa.

Hawkeye Radio Association News.

The Hawkeye Radio Association, Iowa's booming wireless organization, had a big exhibit at the Iowa State Fair, held at Des Moines, August twenty-three to September one, inclusive. A very large antenna was erected, which, with the modern apparatus in the exhibit, enabled them to receive from all the high-powered stations in this hemisphere, as well as those on the continent. Heterodyne receivers and all the latest apparatus were on exhibit and gladly explained. Complete transmitters were installed and working during the Fair under a special license. QST reports, etc., were sent out daily.

During the week of the State Fair the annual convention of the club was held at the Y.M.C.A. building at Des Moines. Lectures, talks, etc., were given by various members and a "Round Table" held. Also the members chose their officers for the coming year and conducted all necessary business. Every radio enthusiast in the State of Iowa was cordially invited to join this club. Any further information will be gladly given. Address, Arthur B. Church, Secretary, Lamoni, Iowa.

Dot and Dash Club of East Orange, N.J.

A Radio Club has been established under the name of the "Dot and Dash Club" in East Orange, N.J. The officers are: President, Charles Summers; vice-president, Cortenay Whitman, and secretary, F. F. Brothers. The purpose of the club is to promote interest in radio telegraphy. Dot and Dash Club, F. F. Brothers, secretary.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur News" Section, The Electrical Experimenter, 233 Fulton St., New York City.

Now "Bugs" for the Yorkville Radio Development Association.

Now "Bugs" for the Yorkville Radio Development Association. This organization since its establishment has grown lustily and now has a membership of sixty-three. It might as well be said that the position of Secretary has changed hands several times, because the Secretary usually complains of throat trouble after going through the roll call half-way. Most of the members became such only through reading the columns of THE ELECTRICAL EXPERIMENTER.

It might be remembered that the Y.R.D.A. had a write-up in the February issue of THE ELECTRICAL EXPERIMENTER. Well, the Y.R.D.A. obtained fifty members through that write-up, which illustrates the enormous popularity of The E. E. with the scientific men of the country. As the membership has risen to the maximum (sixty-three), it will be impossible to enlist any more new members. The scientific work done by members in four months is given below:

February.—Mr. F. Smith, assistant to Joseph L. Cermak, developed a new chemical compound for use in electroion detectors. It will be put on the market shortly.

March.—Mr. Joseph L. Cermak, E.E., made a combination of chlorine and another gas, which is being successfully used to bleach discolored perlmutter buttons.

Messrs. Cermak, Smith and Goodman presented the Naval Advisory Board with three inventions—namely, a land torpedo, an unsweepable mine and a projectile for use on Zeppelins. They were thanked by the board for their services.

May.—Inventions of small importance were made by the following:

Gas detector, Joseph L. Cermak.

New mineral detector, F. Harvey.

Protection of aluminium-aerial wire from corrosion, F. Smith.

New Audion hook-up, T. Gerad.

Pocket radio set designed, B. F. Badrow.

Phone intensifying diaphragm, Joseph L. Cermak.

Diminutive spark coil of great strength, Joseph L. Cermak.

This completes the work for May. As may be observed, the officers and members have taken a very great interest in the work of developing the radio art.

The President, Mr. Joseph L. Cermak, E.E., 73 East End Avenue, New York City, N.Y., will be pleased to answer all inquiries regarding this Association's work.

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR UNTIL THE NEXT ANNUAL GOVERNMENT CALL BOOK.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of April, 1916. (Continued.)

EIGHTH DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
8AIZ	Thornton, Wallace W.	258 Madison Ave., Youngstown Ohio	.5
8AHS	Walrath, Floyd E.	DeKalb Junction, N. Y.	.5
8AFR	Walser, Arthur L.	Chesaning, Mich.	.5
8JQ	Young Men's Christ. Ass'n.	110 Fourth Ave., Ann Arbor, Mich.	

NINTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
9OE	Andreen, Earl H.	1204 Belknap St., Superior, Wisc.	.5
9AEP	Avery, Norman K.	307 Bigelow Ave., Peoria, Ill.	1
9RD	Bailey, Frank M.	525 Kenilworth Ct., Clinton, Iowa	1
9CQ	Behmer, Wm.	1335 S. Kolin Ave., Chicago, Ill.	.5
9NP	Buckley, Harold J.	1206 Wrightwood Ave., Chicago, Ill.	.5
9QH	Brockschmidt, Wesley E.	173 Foote Ave., Bellevue, Ky.	.5
9AFT	Blum, Sidney J.	4105 Campbell St., Kansas City, Mo.	1
9AGA	Bornofska, Clar. & Elmer	1322 Lincoln St., Racine, Wisc.	.5
9AEN	Brewster, Vernon H.	Crystal Lake, Ill.	.5
9AFW	Bechtold, Joe and Fred V.	North Manchester Ind.	.5
9AFS	Busey, Paul G.	911 W. Nevada St., Urbana, Ill.	1
9AEV	Coffman, Scott	61 N. Gale St., Indianapolis, Ind.	1
9AFU	Clayton, Harold H.	R. F. D. No. 5, Monroeville, Ind.	.5
9NG	Cramer, Wilbur R.	5130 S. 40th St., Omaha, Neb.	.5
9AEZ	Egloff, Edward & Martin	2729 W. Barry Ave., Chicago, Ill.	1
9AES	Garrett, Hallie C.	810 E. 40th St., Kansas City, Mo.	1
9BZ	Goddard, C.	Shawnee, Kans.	.5
9AEO	Hall, Alfred H.	4015 Alcott St., Denver, Colo.	1
9AEU	Haitz, Fred, Jr.	3901 Fourth Ave., Sioux City, Iowa	.5
9PB	Hancock, Leverne	1209 13th St., Superior, Wisc.	.5

NINTH DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
9AFO	Harris, Harvey P.	902 Burns St., Alton, Ill.	.5
9AFE	Howard, John C.	311 S. State St., Champaign, Ill.	1
9IA	Huckett, Edwin W.	402 N. Oakley St., Kansas City, Mo.	.5
9AET	Huff, Fred W.	4328 Tracy Ave., Kansas City, Mo	1
9AFA	Jaroszewicz, Casimir	1330 W. 50th St., Chicago, Ill.	.5
9AFD	Krus, Carl	4652 N. Hermitage Ave., Chicago, Ill.	.5
9QA	Larson, Lee H.	2020 Telegraph Rd., Davenport, Ia.	.5
9AER	Marshall, Geo.	2045 S. Lawrence Ave., Wichita Kans.	
9AEY	Matzinger, Philip F.	1956 W. 94th St., Chicago, Ill.	.5
9PJ	Maxfield, David C.	Le Roy, Minn.	1
9TV	Ostermeier, Cecil H.	529 W. Jefferson St., Springfield, Ill.	.5
9AFG	Nevling, Lorin I.	4240 Maffitt Ave., St. Louis, Mo.	.5
9AFR	Phillips, Claude B.	Lucca N. D.	.5
9AEQ	Richards, John	2508 Ames Ave., Omaha, Neb.	.5
9AFI	Sprackling, Geo. A.	602 Milwaukee, Ave., Janesville, Wis.	.5
9AFM	Swain, Raymond E.	2828 Highland Pl., Indianapolis, Ind.	.5
9AFN	Swanson, Martin	1900 Western Ave., Minneapolis, Minn.	.5
9OF	Vollmar, Harold V.	909 Wall St., Milwaukee, Wisc.	.5
9AEX	Wareing, Thomas	2615 Seminary Ave., Chicago, Ill.	.5
9AFK	Whitcomb, Donald L.	406 N. Lawndale St., Kansas City, Mo.	.5
9PU	Wilhelmy, Lino M.	418 S. Main St., Decatur, Ill.	.5

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of May, 1916.

FIRST DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
1KR	Anderson, Andrew R.	29 Lewis St., Lynn, Mass.	.5
1DK	Anderson, Herbert	833 Norman St., Bridgeport, Conn.	.5
1ES	Armstrong, Leroy W.	135 Point St., Providence, R. I.	.5
1JN	Billotte, Louis C.	10 Centennial Ave., Revere, Mass.	.5
1ESV	Ashland, Homer B.	76 N. Union St., Burlington, Vt.	.5
1MZ	Clark, Lyman J.	Cuttyhunk Light Station, Goswold, Mass.	.5
1SX	Boy Scouts of America Troop 2	Cambridge, Mass. (License in name of E. L. Gookin, Scoutmaster)	.5
1UF	Caldwell, Raymond P.	18 Morton St., Providence, R. I.	1
1MD	Caswell, Carlton T.	106 Franklin St., Framingham, Mass.	.5
1DH	Cook, Lewis W.	49 Pleasant St., Ansonia, Conn.	.5
1DO	Cook, Witter T.	460 W. Main St., Norwich, Conn.	.5
1SB	Corcoran, Thomas A.	Cambridge, Mass.	.5
1ESW	Dodge, William E.	Beverly, Mass.	.5
1EST	Eaton, Richard E.	59 Lovett St., Beverly, Mass.	.5
1NI	Folin, George G.	133 Buckminster St., Brookline, Mass.	.5
1ON	Cosgrove, Roland D.	14 Wright St., Cambridge, Mass.	.5
1NO	Davis, Orin F.	124 Pearl St., Somerville, Mass.	
1PD	Folsom, Owen F.	89 Hewlett St., Boston, Mass.	.5
1KT	Fruch, Frederick G.	962 South St., Roslindale, Mass.	.5
1SR	Gray, Hollis L.	29 Vine St., Medford, Mass.	.5
1IT	Hahn, P. Francis	St. Anselms College, Manchester, N. H.	1
1FH	Ham, Miles F.	21 Crosby St., Augusta, Me.	1
1JR	Harding, David W.	Vineyard Haven, Mass.	.5
1ESQ	Hasbrouck, Louis	130 N. Plesant St., Amherst, Mass.	.5
1OC	Henry, Hugh M.	Rochester, Vt.	.5
1MN	Hodgdon, Milo L.	24 Wachusett St., Worcester, Mass.	
1FW	Holton, Albert M.	11 Florida St., Springfield, Mass.	.5
1AU	Huntington, Charles E.	3 Orange St., Newburyport, Mass	
1DA	Johnson, Arthur A.	Cromwell, Conn.	.5
1MI	Kelly, Richard P.	8 O St., South Boston, Mass.	.5
1DF	Kelsey, Philip C.	Ivoryton, Conn.	1
1NZ	Knight, George W.	29 Central St., Manchester, Mass.	.5
1LZ	Knight, Montgomery	475 Appleton St., Holyoke, Mass.	1
1FL	Larrabee, Charles W.	176 Prospect St., Portland, Me.	.5
1JA	Leathers, John W.	78 Bay State Ave., Somerville, Mass.	.5
1PQ	Leavitt, Vernal A.	26 Lafayette St., Portland, Me.	.5
1MR	Leonard, Frederick D.	353 S. Main St., Mansfield, Mass.	.5
1ESR	Leonard, Theodore	1188 State St., Bridgeport, Conn.	.5
1UT	Marcroft, Jesse	Warwick, R. I.	.5
1EY	Marcroft, William	235 Northup St., Cranston, R. I.	.5
1MC	Murray, Albert F.	21 Norway St., Boston, Mass.	.5
1ND	Mix, Donald G.	1 Kensington Heights, Worcester, Mass.	1
1KN	Plaisted, Frank H.	142 Davis Ave., Brookline, Mass.	.5
1ST	Reynolds, J. Louis	20 Gordon St., Framingham, Mass.	.5
1GE	Reynolds, William B.	37 State St., Framingham Center, Mass.	.5
1DI	Rhodes, Clarence A.	50 Sedgewick St., Bridgeport, Conn.	.5
1AEN	Rosen, Victor E.	33 Woodlawn St., Lynn, Mass.	.5
1UW	Rowe, Austin E.	110 Loring Rd., Winthrop, Mass.	1
1IM	Senay, Charles T.	Saugus High School, Saugus, Mass.	1
1IV	Sherman, Israel	55 Revere St., Boston, Mass.	.5
1VN	Southworth, Palmer H.	34 Montowese St., Hartford, Conn.	1
1FY	Stevens, Charles R.	30 Worcester St., Framingham Center, Mass.	.5
1OD	Taylor, Walter A.	3 Thurston St., Somerville, Mass.	.5
1KZ	Waldie, Thomas G.	21 Woodbury St., Beverly, Mass.	.5
1JW	Walker, J. Frank	Kittery, Me.	.5

SECOND DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
2AQO	Alexander, Bronson H.	600 W. 183d St., New York, N. Y.	.5
2ARF	Allen, Edwin W., and James J., Jr.	Chatham, N. J.	.5
2ARV	Appell, Daniel T.	41 St. Nicholas Ter., New York, N. Y.	.5
2APE	Averill, William H.	Sayville, N. J.	1
2ARA	Balison, Howard	361 Eastern Parkway, Brooklyn, N. Y.	.5
2AQP	Bargebuhr, Herbert M.	649 W. 184th St., New York, N. Y.	.5

SECOND DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
2AQS	Bohman, Albert	122 Wilbur Ave., Long Island City, N. Y.	.5
2ARG	Bona, Edward	82 Van Nostrand Ave., Jersey City, N. J.	.5
2ARN	Bremer, Frank V.	3613 Boulevard, Jersey City, N. J.	.5
2ARP	Campbell, George C.	92 Highland Ave., Yonkers, N. Y.	1
2APY	Charleston, Eugene E.	1628 11th Ave., Brooklyn, N. Y.	.5
2ARR	Cohen, Monte	310 W. 14th St., New York, N. Y.	.5
2KA	Coote, Charles W.	586 177th St., New York, N. Y. Public School No. 115.	.5
2ARX	Dickinson, Edwin A.	1038 Garden St., Hoboken, N. J.	.5
2ARM	Dimmick, E. Ray	230½ 4th St., Jersey City, N. J.	1
2PM	Faraon, Adolph J.	Belle Harbor, N. Y.	1
2ARC	Ferguson, George M.	303 Stuyvesant Ave., Brooklyn, N. Y.	.5
2AQW	Frankenstein, Edwin S.	97 Bruce Ave., Yonkers, N. Y.	.5
2AQT	Ferris, Clinton S.	409 Smith St., Peekskill, N. Y.	1
2ARS	Grece, Joseph F.	134 Manhattan Ave., Jersey City, N. J.	.5
2AQR	Grover, Paul B.	Toms River, N. J.	.5
2AQZ	Hall, Norman C.	47 Hill St., Newark, N. J.	.5
2ART	Hammond, George P.	1855 70th St., Brooklyn, N. Y.	.5
2AQQ	Hoffman, Frank	Keansburg, N. J.	.5
2APV	Hymmen, Robert	100 Armstrong Ave., Jersey City, N. J.	.5
2ARW	Jockers, Edwin B.	142 Ridge St., Newark, N. J.	.5
2APU	Krantz, Hubert K.	183 Argyle Rd., Brooklyn, N. Y.	.5
2AQK	Lambert, Fred F.	300 Sickles Ave., NewRochelle, N.Y.	1
2ARJ	Leiter, David	262 Delancey St., New York, N. Y.	.5
2ARK	McCoy, Lester M.	R. F. D. No. 2, Peekskill, N. Y.	.5
2ARU	Machlett, Raymond R.	131 W. 188th St., New York, N. Y.	.5
2ARQ	Miller, Raymond H.	327 Hillside Ave., Newark, N. J.	1
2KF	Nolan, George T.	449 E. 183d St., New York, N. Y.	.5
2AED	Oechler, Alfred C.	82 Smith St., Irvington, N. J.	.5
2ARI	Pawley, Myron G.	513 2nd Ave., Asbury Park, N. J.	.5
2ARL	Perry, Irving D.	68 N. Parkway, East Orange, N. J.	.5
2ARB	Plauth, William	179 Euclid Ave., Brooklyn, N. Y.	1
2ARH	Randell, Edward J.	Fort Totten, N. Y.	.5
2AQY	Showalter, John W.	333 Birch St., Richmond Hill, N.Y.	.5
2AQU	Smith, E. Carter	572 W. 187th St., New York, N. Y.	.5
2AQV	Sommer, Isidor	56 Columbia St., New York, N. Y.	.5
2ARE	Southard, Sealey M.	32 Raynor St., Freeport, N. Y.	.5
2APW	Vanderbilt, Harold W.	205 Park Pl., Brooklyn, N. Y.	.5

THIRD DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
3VG	Applegate, Franklin & Macpherson	34 Hillcrest Ave., Trenton, N. J.	.5
3QT	Bayard, Arnold	Woodbine, N. J.	1
3FT	Bisciotti, Bernard J.	608 Carpenter St., Philadelphia, Pa.	.5
3ATN	Briscoe, James D.	Hyattsville, Md.	.5
3VB	Butt, Harvey R.	1307 Moran Ave., Norfolk, Va.	.5
3AEA	Craigie, Stuart M.	511 W. Grace St., Richmond, Va.	.5
3AEW	Dicks, Grover C.	Hagerstown, Md.	.5
3ADR	Endress, John N.	2430 Jefferson St., Harrisburg, Pa.	1
3AHI	Giles, Larkin	1307 Clayton St., Wilmington, Del.	.5
3ADF	Harrell, Leonard B.	900 Holladay St., Portsmouth, Va.	.5
3PV	Hiestand, Benjamin	Marietta, Pa.	.5
3AAB	Lansford, Willis R.	3607 13th St., N. W., Washington, D. C.	.5
3QC	Lever, Haseltine S.	Abington, Pa.	.5
3ADE	Layton, Howard H.	805 Washington St., Wilmington, Del.	.5
3DY	Lynn, Thomas H.	Hyattsville, Md.	.5
3SJ	McIntosh, Howard F.	4218 Thompson St., Philadelphia, Pa.	.5
3TS	Mandeville, Francis T.	116 Church St., Boonton, N. J.	.5
3RK	Mecaslin, Harry B.	3903 Hawthorne Ave., Baltimore, Md.	1
3ATM	Morgan, Joseph, Jr.	408 Tioga St., Johnstown, Pa.	1
3IO	Morgan, Joseph, Jr.	314 W. Seymour St., Germantown, Pa.	.5
3AEK	Lewis, Samuel W.	121-B North Mass. Ave., Atlantic City, N. J.	.5
3MY	Moyer, Edgar F.	561 Broad St., Emaus, Pa.	.5
3ADG	Roehm, Sewall	501 Upland Ave., Noble, Pa.	.5

Continued on opposite page.

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR UNTIL THE NEXT ANNUAL GOVERNMENT CALL BOOK.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of May, 1916. (Continued.)

THIRD DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
3AP	Scheetz, Edwin F.	Wyncote, Pa.	.5
3GY	Swinney, Walter, Jr.	815 N. Mount St., Baltimore, Md.	.5
3TF	Thorborg, Martin E.	230 Seymour St., Philadelphia, Pa.	.5
3OZ	Twine, Roy W.	319 W. 28th St., Norfolk, Va.	1
3ATK	Viessman, Warren	2711 Twoly Ave., Baltimore, Md.	.5
3ADW	Walker, Orville R.	134 S. 17th St., Allentown, Pa.	.5
3AIL	Wallace, M. Edgar	38 Prospect St., Trenton, N. J.	1
3AGA	Weikel, John H.	900 Church St., North Wales, Pa.	.5
3AGD	Westlake, Harry T.	1922 N. Broad St., Philadelphia, Pa.	.5
3BR	Witty, Gustav	1608 W. Allegheny St., Philadelphia, Pa.	1
3AAH	Wohlsen, Richard	430 W. Orange St., Lancaster, Pa.	1
3RS	Yearley, Clifton K.	Garrison and Fernhill Aves., Baltimore, Md.	1
3ATO	Zapp, Frederick A.	469 Rutherford St., Trenton, N. J.	.5

FOURTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
4DX	Benning, Broughton W.	50 Whiteford Ave., Atlanta, Ga.	.5
4CD	Elston, Esmond B.	227 5th St., S., St. Petersburg, Fla.	1
4EB	Barrey, Owen J.	Nazareth, N. C.	.5
4CG	Holtzclaw, Ralph C.	Roseland, Fla.	.5
4EA	Huggins, William C.	7 S. 4th St., Wilmington, N. C.	1
4DY	Raffo, James H.	Bay Shore Boulevard, Tampa, Fla.	1
4CA	Shaham, J. Hubert	315 W. 5th St., Rome, Ga.	1
4EC	Shumate, John R., Jr.	600 Clay St., Thomasville, Ga.	1
4DZ	Stone, Hector A.	Lockhart, Fla.	.5

FIFTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
5EM	Dawty, Albert	5918 Laurel St., New Orleans, La.	.5
5EP	Fort, Fred A.	2222 Portland Ave., Shreveport, La.	.5
5EN	Harrison, W. Mace	1003 Elgin Ave., Muskogee, Okla.	.5
5EO	Mottashed, Marvin H.	3126 Lillian St., Shreveport, La.	.5

SIXTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
6RQ	Abrahamson, Ray	4220 California St., San Francisco, Cal.	.5
6OA	Adams, Eugene R.	Mountain View, Cal.	.5
6OP	Altland, Comer P.	662 Clayton St., San Francisco, Cal.	.5
6MQ	Anderson, Sante H.	Mayfield, Cal.	.5
6ON	Becker, Peter J.	2722 Harvard Blvd., Los Angeles, Cal.	.5
6VH	Blackstone, Clifford M.	1606 W. 50th St., Los Angeles, Cal.	.5
6DA	Bolton, Harold B.	4300 Judah St., San Francisco, Cal.	.5
6FY	Bonar, Perry	837 4th St., Santa Rosa, Cal.	.5
6VM	Clark, Herbert	578 16th St., Oakland, Cal.	.5
6QE	Clewett, Heber H.	1002 S. Reservoir St., Pomona, Cal.	.5
6UJ	Day, Elwin C.	907 Valencia St., San Francisco, Cal.	.5
6UV	Fassett, Lee	4326 Balboa St., San Francisco, Cal.	.5
6PP	Ferrill, Wm.	El Cajon, Cal.	.5
6FQ	Foster, Harold M.	630 Culver St., Orange, Cal.	.5
6VG	Fowler, L. Deane	1027 6th St., Redlands, Cal.	.5
6IU	Hutchinson, Howard W.	614 S. Brand Blvd., Glendale, Cal.	.5
6CQ	Kemper, Horace L.	173½ Loma Drive, Los Angeles, Cal	.5
6VJ	Kinsman, Joseph W.	3467 Arroyo Seco Ave., Los Angeles, Cal.	.5
6DR	Laverty, Finley B	5332 Abbott Pl., Los Angeles, Cal.	.5
6VF	Leigh, Philip P.	827 2d St., Santa Monica, Cal.	1
6UR	Link, Ralph L.	1520 Annan Way, Los Angeles, Cal.	.5
6JJ	Klahn, Leander	27 Chenery St., San Francisco, Cal.	.5
6MM	Moore, Norval E.	652 E. Culver St., Orange, Cal.	.5
6TI	O'Dell, James J.	327 Post St., San Jose, Cal.	.5
6SO	Parkin, Gladys Kathleen	22 Terra Dillo Ave., San Rafael, Cal.	.5
6QC	Perry, Oliver A.	Meridian and Q Sts., San Diego, Cal.	.5
6TK	Robinson, Sidney E.	2929 Broadway, Oakland, Cal.	.5
6DQ	Sleeper, James L.	211 Orange Ave., Santa Ana, Cal.	.5
6KZ	Smith, Harold	3415 Glen Albyn Drive, Los Angeles, Cal.	.5
6QN	Snider, Wallace	2031 E. 1st St., Long Beach, Cal.	.5
6GO	Summers, James W.	1061 62d St., Oakland, Cal.	.5
6GQ	Thurman, Alvin C.	7 Grant Ave., Watsonville, Cal.	.5
6TC	Wright, Howard E.	315 Alvarada Court, Pomona, Cal.	.5

SEVENTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
7KK	Adams, Le Roi T.	364 Monroe St., Portland, Ore.	.5
7OF	Allard, Ambrose	Evanston, Wyo.	.5
7BU	Barrell, Dana A.	839 W. Pennsylvania Ave., Medford, Ore.	1
7OK	Bode, Hugo P.	6315 Beacon Ave., Seattle, Wash.	.5
7CV	Clark, G. Warren	Lents, Ore.	.5
7CA	Crosby, Edward J.	508 E. Sharp Ave., Spokane, Wash.	.5
7CD	De Lacy, Clinton	1906 South J St., Tacoma, Wash.	.5
7NB	Duncan, Thomas W.	802 Gerald Ave., Missoula, Mont.	.5
7CN	Emigh, Charles	335 Grove St., Walla Walla, Wash.	1
7FS	Horstman, Herschel J.	807 4th St., La Grange, Ore.	...
7PJ	Jones, Paul	Wheatland, Wyo.	.5
7NI	Learned, George H.	Forest Grove, Ore.	.5
7LQ	Linsley, Harry	Evanston, Wyo.	.5
7LL	Lunan, Leslie	806 South M St., Tacoma, Wash.	.5
7LN	Lyman, Rollo	905 N. Ave., La Grande, Ore.	.5
7QN	Moore, E. H.	Queen Anne High School, Seattle, Wash.	5
7PK	Palmer, Robert S.	1321 Columbia St., Hood River, Ore.	.5
7PL	Patterson, Fred	865 Williams Ave., Portland, Ore.	1
7JU	Tuerck, John K.	495 Harrison St., Portland, Ore.	.5
7MO	Smith, George M.	Eatonville, Wash.	.5
7UA	Wallace, George H.	Vancouver, Wash.	.5
7AU	Wilkinson, Albert E.	Y. M. C. A. Bldg., Baker, Ore.	.5

EIGHTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
8ACR	Atkinson, Ward I.	95 Rutgers St., Rochester, N. Y.	.5
8AJU	Bell, Charles H.	5153 Flower Ave., Cleveland, Ohio	.5
8AJG	Braatz, Eugene C.	Lowellville, Ohio	.5
8SV	Bratton, Harry B.	Brecksville, Ohio	.5
8AEX	Calkins, Norman	2136 W. 100th St., Cleveland, Ohio.	.5
8ASJ	Conner, Charles E.	726 Clinton St., Kalamazoo, Mich.	.5
8ASO	Carr, Irving E.	1246 Roosevelt Ave., Flint, Mich.	.5
8AEG	Cawley, Eugene H.	301 Chestnut St., Dunmore, Pa.	.5
8ASV	Davidson, Robert L.	50 N. 3d St., Newark, Ohio	.5
8AEY	Davis, Harold P.	2095 W. 87th St., Cleveland, Ohio.	1
8ASD	Dunmore, Wallace P.	218 Main St., Binghamton, N. Y.	.5
8ASK	Evans, Jack H.	806 Bayridge Ave., Pittsburgh, Pa.	.5
8ASH	Finegan, George W.	494 Columbia Ave., Rochester, N.Y.	1

EIGHTH DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
8ASG	Flory, Carl L.	119 W. Decatur St., Eaton, Ohio.	.5
8ASN	Fisk, Rufus	98 Park Ave., Binghamton, N. Y.	.5
8ASP	Gamble, Howard B.	2537 E. 128th St., Cleveland, Ohio.	1
8ASQ	Greenwell, Robert	6302 Utica St., Cleveland, Ohio.	1
8ADE	Hantman, Alexander	21 Vine St., Pittsburgh, Pa.	1
8AGS	Hart, I. Bruce	1215 S. Arch Ave., Alliance, O.	.5
8AST	Hills, Harold C.	Palermo, N. Y.	.5
8ASG	Howsare, George D.	119 W. Decatur St., Eaton, O.	.5
8AKA	Kepler, Ralph E.	210 Allen St., Dayton, O.	.5
8ASC	Kidd, J. Wm.	606 Cherry St., Niles, O.	1
8AJN	Knott, Charles E.	107 Stedman, Sayre, Pa.	1
8ASA	Lininger, Clarence R.	614 N. Broad St., Ridgway, Pa.	1
8ASB	Millspaugh, Frederick	37 Gaylord St., Binghamton, N. Y.	.5
8AGK	Morris, Carleton D.	31 Monroe St., Monroeville, O.	.5
8ASS	Olney, Clarke	28 Roxford Rd., E. Cleveland, O.	.5
8ASR	Paul, George	2950 E. 57th St., Cleveland, O.	1
8ASL	Proutey, Laurence	175 De Russey St., Binghamton, N. Y.	.5
8ASI	Roe, Millard J.	909 Egleston Ave., Kalamazoo, Mich.	.5
8ASW	Sager, Merel	44 Apple St., Tiffin, O.	.5
8AEE	Schmid, Paul J.	821 Main St., Columbus, O.	.5
8ARY	Spitler, Stephen	Continental, O.	.5
8ASF	Stolzenbach, Robert W. and Charles H.	724 W. Market St., Lima, O.	1
8AD	Stybr, Gilbert	R. F. D. No. 3, Bellevue, Pa.	.5
8ADR	Sullcharger, John A.	1412 Woodbourne Ave., Pittsburgh, Pa.	.5
8IQ	The Electro-Set Co.	3200 Franklin Ave., Cleveland, O.	1
8ASM	Terry, Donald M.	Scott, O.	.5
8FX	Thomas, Norman A.	512 7th St., Marietta, O.	.5
8ARZ	Wilson, Harold H.	Silver Creek, N. Y.	.5
8ASU	Yotter, Francis P.	Freeport, Pa.	.5

NINTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
9AGD	Banks, Archie E.	R. F. D. No. 2, Delmar, Iowa	.5
9AGW	Barnett, Forrest	2015 Western Ave., Mattoon, Ill.	.5
9AGP	Barrett, Paul G.	3150 Central Ave., Indianapolis, Ind.	.5
9AGX	Bean, Mason	521 E. High St., Jefferson City, Mo.	.5
9AGS	Becker, Paul M.	4427 Greenwood Ave., Chicago, Ill.	.5
9AIC	Bliss, Sidney H.	120 Jackman St., Janesville, Wis.	.5
9AGU	Briscoe, Bertram O.	848 La Salle St., Chicago, Ill.	.5
9AGN	Brittin, Frank L.	1149 W. Edwards St., Springfield, Ill.	1
9AGY	Brodnax, Lewis M.	3526 Walnut St., Kansas City, Mo.	1
9AHU	Buck, Donald N.	3332 Kenmore Ave., Chicago, Ill.	.5
9AHW	Call, George R.	1529 Pearl St., Sioux City, Iowa	1
9AIA	Campbell, Albert	4243 W. Congress St., Chicago, Ill.	.5
9AGF	Canary, Elmer B.	810 E. North St., Indianapolis, Ind.	.5
9AIJ	Cook, George S.	1932 Penn. Ave., S., Minneapolis, Minn.	1
9AGG	Cottrell, Gorham J.	1628 Jersey St., Quincy, Ill.	.5
9AGQ	Davis, Herbert	6141 S. Kolbourne Ave., Chicago, Ill.	1
9AHK	Drummond, Ralph	Oglesby, Ill.	.5
9AGZ	Engel, Roman	664 48th St., Milwaukee, Wis.	.5
9AIF	Fawcett, Lester S.	206 3d Ave., S. W., Independence, Iowa	1
9AGH	Fenner, Zell G.	23 E. Washington St., Colfax, Iowa.	1
9AIN	Ferguson, Wm. B.	108 N. 17th St., Richmond, Ind.	1
9AGV	Fiedler, Herbert W.	1142 Diversey Parkway, Chicago, Ill.	.5
9AGE	Gamble, Glen A.	4329 Burdette St., Omaha, Neb.	1
9AHA	Gates, George B.	942 Superior St., Racine, Wis.	1
9AHT	Glavin, Roland E.	748 Lawndale Ave., South Bend, Ind.	1
9AGO	Groth, Wm. A.	1534 W. Locust St., Davenport, Ia.	.5
9AHE	Harlin, Paige J.	3704 S. Bryant Ave., Minneapolis, Minn.	.5
9RF	Harmegnies, Paul E.	730 Wisconsin Ave., Oak Park, Ill.	.5
9DY	Healy, Kent T.	849 Willow St., Winnetka, Ill.	.5
9AGG	Herrling, Raymond C.	856 Prospect St., Elgin, Ill.	.5
9QE	Hopkins, Stanley W.	520 Greenleaf Ave., Glencoe, Ill.	.5
9AIL	Howard, Chas. B.	1712 E. Jackson St., Springfield, Ill.	.5
9AU	Iversen, Reginald J.	422 S. 16th Ave., Maywood, Ill.	1
9AIK	Jordan, Jacob	Jefferson High School, Lafayette, Ind.	1
9AGM	Knodle, Almon S.	1942 Talbott Ave., Indianapolis, Ind.	.5
9RO	Lethen, Edward	4312 Greenview Ave., Chicago, Ill.	.5
9AII	Lipe, Corodon C.	1243 W. Wood St., Decatur, Ill.	.5
9AID	Lockhart, Ashton	Casselton, N. D.	.5
9AIM	Mackley, Harry A.	420 Dechman Ave., Peoria, Ill.	1
9AHD	Mase, Harold E.	3335 Hennepin Ave., Minneapolis, Minn.	.5
9AGK	Messing, Marvin M.	27 Shaffer St., Freeport, Ill.	.5
9AIH	Morton, Charles E.	520 Schwartz St., Edwardsville, Ill.	.5
9AHI	Nelson, G. Adolph	5518 W. 8th St., Duluth, Minn.	.5
9IV	Olsen, Winard G.	1454 Pensacola Ave., Chicago, Ill.	1

Attention! Radio Amateurs.

DO you find this advance list of "Licensed Radio Amateurs" published monthly of real benefit? If not, we would just as soon publish additional pages of other matter in the Radio, Constructor and How-to-make-it Sections. Now is your chance to let us know which you prefer. Just mail us a postcard and say —"I ***do not*** want the list of "Licensed Amateurs continued" or "***I do*** want the list of Licensed Amateurs continued." Address the Editor, 233 Fulton St., New York City.

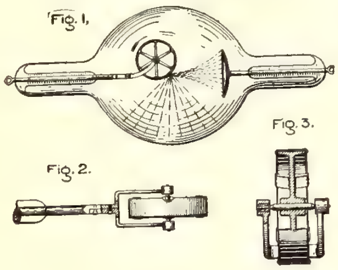
(To be Continued)

LATEST PATENTS

Improved X-Ray Tube

(No. 1,192,706; issued to Elihu Thompson.)

In this invention over-heating of the focal spot, the part of the surface of the target or anticathode subjected to the bombardment of the cathode rays is prevented by successively renewing the target surface during the operation of the tube, for example, by making the

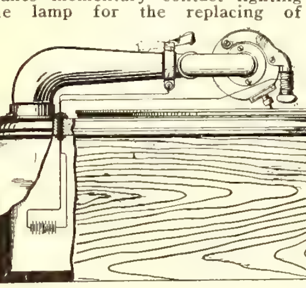


target in the shape of a wheel or disc and rotating the same in any way, as by external means or by the reaction of the rays striking the rim of the target tangentially.

Electric Light for Phonographs

(No. 1,193,825; issued to Clarence H. Roop.)

This patent covers the use of a miniature electric light attached to the phonograph reproducer head and capable of being operated from a flashlight battery. A switch is provided, which, when pressed downward in a forward direction, makes momentary contact lighting the lamp for the replacing of

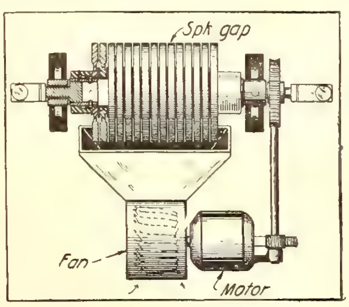


needles when playing in the dark, etc.; when thrown backward it closes the circuit permanently until thrown upward again. It is designed to be manufactured as a separate attachment. A very marketable idea which can be sold at a reasonable price.

Radio Spark Gap

(No. 1,192,909; issued to Fred H. Kroger.)

The inventor of this spark gap for radio transmitting circuits claims to obtain similar results to those attainable with regular quenched gaps.



A small motor carries a fan blade, which projects a stream of air against the multiple metal plates of the gap, and also the motor carries a worm and connecting gears, which rotate the complete gap unit.

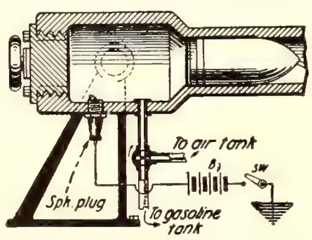
The sparks occur between the exposed plate rims in the open air and occur usually in proximity to the draft tube, which is made of insulating material. Thus, the sparks are caused to take place evenly in so far as wear on the plates is concerned, owing to the rotation of the complete element.

Moreover, this gap serves as a "resonance indicator" for when the gap becomes noisy the circuits are not properly adjusted; when the tuning is good the sparks occur near the center of the plates and the noise is a minimum.

Electric Gasolene Gun

(No. 1,192,839. Issued to Alonzo O. Armour)

A new form of cannon utilizing the energy of an explosive charge of gasolene and air for driving the shell out of the barrel. As becomes clear from the illustration the gasolene and compressed air are admitted in appropriate quantities to the explosion chamber at the breech of the cannon, and this mixture is



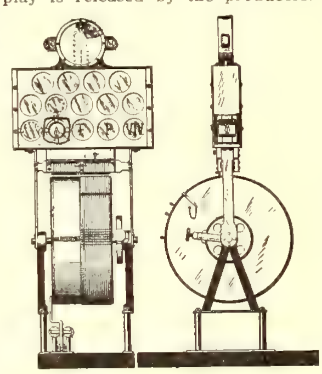
fired by an electric ignition spark plug, thus driving out the projectile with great force.

A suitable mechanism may be used to facilitate the rapid reloading of the gun and other combustible fluids may be used in lieu of gasolene.

Photo-Play Orchestral Director

(No. 1,194,517; issued to Stanley W. Lawton.)

An ingenious idea involving the use of a master musical direction chart, to be made when the film-play is released by the producers.



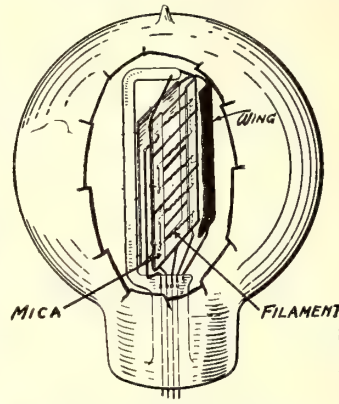
The theater operator places his perforated master chart around the large drum here shown, and in each perforation a plug is inserted. The drum rotates synchronously with the rotation of the motion picture projector mechanism.

The various projecting plugs on the drum operate proper switches, controlling electric lamps behind the glass dial-board before the orchestra director. Each glass disk contains the "key" word relating to the forthcoming section of the picture and the kind of music that is to be played to accompany it. These "keys" represent such terms as allegro, moderato, andante, adagio, tremolo, segue, pianissimo, forte, drum, organ, etc.

Thermionic Amplifier and Rectifier

(No. 1,193,206; issued to Hendrik Johannes van der Bijl.)

An improvement in the filament of a vacuum type amplifier and rectifier, involving an arrangement composed of mica strips, through



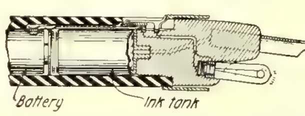
which the heating filament is threaded and thus undue expansion of the filament element is reduced to a minimum.

This permits the filament to be placed in the same, or approximately the same, plane as the grid. The ordinary construction involving the use of supporting springs for the filament has been found to result in a considerable amount of breakage of the heated filament. This of course refers to large, thermionic bulbs of high power rating.

Fountain Pen Flashlight

(No. 1,193,534; issued to Julius Friedman and Joseph L. Friedman.)

A clever design of flashlight and

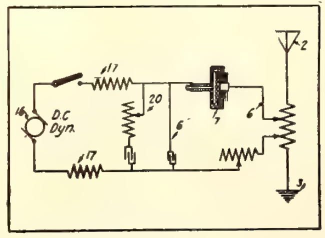


fountain pen combined. The battery supplying current to the miniature lamp, mounted in the pen point, is placed back of a small removable tank containing the ink. The lamp circuit is closed by a spring switch and a threaded sleeve co-acting so as to depress the switch button and keep it there. To open the lamp circuit the sleeve is threaded forward a few turns. A well executed idea but unless the pen barrel is quite large, it would seem difficult to arrange for a reasonable supply of ink.

High Tension D. C. Radio Transmitter

(No. 1,194,154; issued to Melville Eastham.)

An interesting patent covering the use of a 2,500 volt D.C. generator which, with choke coils, forms



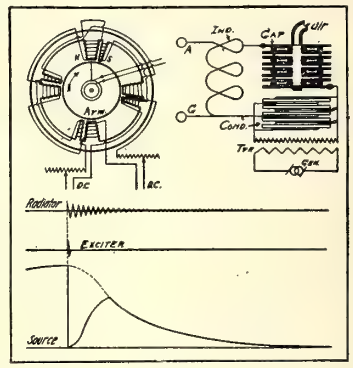
an exciting circuit. This acts on a "reservoir circuit," 20, and an impulse circuit 6. All of these circuits co-act to produce radio frequency oscillations in the radiation (antenna) circuit 2 and 3.

The segmented disc rotary spark gap 7, of well-known pattern, serves to control the frequency of the spark note. The impulse circuit 6, is not oscillatory and oscillations take place only in the antenna circuit 2 and 3. The reservoir circuit 20, helps to keep the energy distributed throughout the system and to realize the highest possible efficiency.

System of Wireless Communication

(No. 1,194,066; issued to John Albert Proctor.)

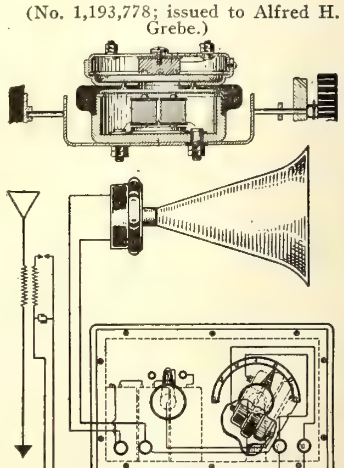
An improved system of radio telegraphy, involving an impact excitation circuit containing a specially designed A.C. generator, as here shown. To obtain the slowly rising, but abruptly falling, A.C. wave form from the alternator, a special field pole arrangement is used. For instance, in the diagram the four larger poles are the regular exciting ones, while the four smaller field poles are of opposite magnetic



polarity. Hence, when an armature inductor revolves in a clock-wise manner, the wave form will be similar to that shown in the graph, resulting in an extremely clean-cut oscillation wave in the radiator (antenna) circuit with practically no reactive wave present, as becomes evident.

Radio Amplifier

(No. 1,193,778; issued to Alfred H. Grebe.)



An amplifier of well-known form intended especially for intensifying the strength of received radio signals. It involves the use of a high resistance, wireless telephone receiver joined acoustically, as indicated, to a sensitive carbon microphone. The microphone controls a low resistance, loud-speaking telephone receiver, fitted with a horn. The receiver and microphone are pivotally mounted in a cabinet, so that it may be rotated slowly to favor different positions in order to favor the microphone action for different or various signal strengths.

COPIES OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

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PHONEY PATENT OFFIZZ

O. de DÂMFLY, OF SWATTER, IR.
SCANATARY FLY ERADAKATOR

No. .0% / .00%

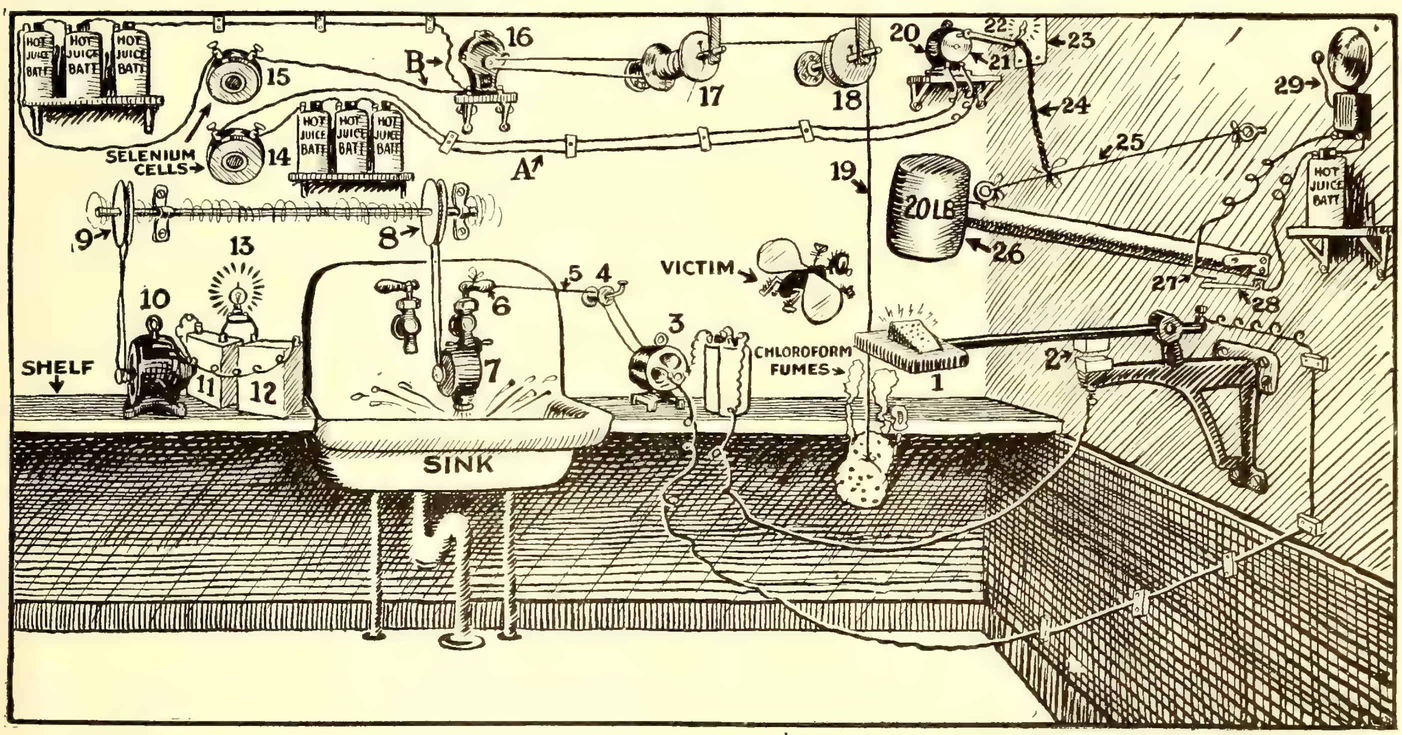
Swatifications of Paty dufoigrâ **Patent Afflicted**

To Whom at Night it Consarns:

Know all mutts by these presents, that I, O. de Dâmfly, a citizen of the City of Swatter, in the State of Irritation, have conceived, devised and perfected a mechanism for annihilating annoying flies in a manner that is entirely painless to the victim.

Owing to the compactness and uniqueness of the Fly Eradakator, it is, when installed, out of the way. It should be placed in the vicinity of the kitchen sink. Owing to the wonderful sensitiveness of the selenium cells, the window shades should be drawn so as to darken the room. Now stand with the right foot pointing toward the North Star and the left pedal extremity pointing in the direction of the Patagonian Desert (this is not an allusion to dessert) and the second joint of the briefest digit of the left hand resting on the right side of the nasal protuberance. Having assumed the posture just described, softly but sweetly and clearly make a noise like a lump of granulated sugar, a piece of Limburger cheese or an embarrassed, mortified stewed prune. A fly, on hearing these familiar sounds, will be attracted to the kitchen, after which you may leave and pursue other work until further notice.

The contrivance is then operated as follows: A piece of Limburger cheese (previously steeped in hard cider and then boiled in molasses) has been placed on platinum plate 1. The hungry fly that was lured to the kitchen lamps the cheese and commences to devour it, its bodily weight causing contact 2 to be closed. This starts motor 3, causing spool 4 to revolve and wind up sky-blue pink silken cord 5, thus opening faucet 6. This starts water motor 7, which rotates pulley 8, which turns shaft thus rotating pulley 9 and thence driving dynamo 10, which charges storage batteries 11 and 12. When these batteries are fully charged they light bulb 13, causing selenium cells 14 and 15 to close circuits A and B. With the closing of circuit B motor 16 is started, which turns pulley 17. This pulley unwinds a black linen cord from pulley 18, causing the same to revolve and unwind lavender cotton string 19, to which is tied a wool sponge saturated with chloroform. The fumes from the sponge permeate the atmosphere in the region of the unsuspecting fly and render the poor, innocent thing unconscious. In the meanwhile, as circuit A was closed motor 20 is started, thus rotating disk 21, on the edge of which is mounted cast-tin shank 22. In end of this shank is fastened a blue-tipped match; from the movement given it by the rotation of disk 21 the match is scratched on coarse sandpaper 23 and ignites. This, in turn, ignites slow-burning fuse 24, which burns string 25, causing twenty-pound lead mallet 26 to descend on unconscious fly, thus crushing it beyond recognition. With the falling of the mallet, spring 27 comes in contact with spring 28 and closes circuit, which rings bell 29, thus calling the housewife or maid. She resets mallet and replaces plate 1 with a new one. Plate 1 is now immersed in a pan of whale's milk that has been sweetened with powdered extract of lemon seed in which it should remain for thirteen hours. After this cruel, harsh treatment, it should be wrapped in waxed paper and buried in sandy loam to a depth of fifteen feet. This lessens all danger of infection from dangerous bacteria which might be residing on the crushed corpse.



The Highly Ingenious "Scanatary Fly Eradakator" Perpetrated on a Long Suffering Public by one, Monsieur O. de Dâmfly, of Swatter, Ir.

In testimony hereof I afflict my illustrious name this 35th day of April B. C. 1313, just 13,213 years after Queen Aristobulus (who had been ironing King Chedorlaomer's pink burlap pajamas) dropped the hot electric iron on her pet hyena Gibbechai, severely scalding its left eyebrow and causing it, because of this grievous injury, to succumb to the ravages of that terrible disease, water on the brain.

(Signed) O. de Dâmfly,
By his Attorney, Morgan C. Aldrich.

Witnesses:

U. F. Athed.
O. Gohang.
U. Ranother.

QUESTION BOX

This department is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

INTERRUPTER.

(646.) Gustave Geier, West Hoboken, New Jersey, asks:

Q. 1. Could six volts, twenty amperes, battery current be transformed into 110 volts?

A. 1. It is impossible to transform a direct current to a higher voltage. If you employ an induction coil with an interrupter, the primary of which should contain 200 turns while the secondary 3,340 turns; it is then possible for you to obtain the required voltage. The form of current obtained at the secondary would not be a direct current but an unsymmetrical alternating one with an enormous decrease in current value. If this current is passed through a closed core transformer, it would be possible for you to convert it into a more nearly sinusoidal alternating current.

Q. 2. What is the best interrupter, a motor-driven segmental drum with brushes or a vibrating spring contact?

A. 2. The drum driven by a motor is the best type of interrupter between the two you mention, but not for all purposes.

WAVE LENGTHS.

(647.) E. A. Simonds, New Orleans, Louisiana, wishes to know:

Q. 1. What is the wave length in meters of an "L" type aerial, 90 feet long, 50 feet high?

A. 1. Two hundred and fifty meters, if made with four strands.

Q. 2. How is the above figured?

A. 2. The wave length of an aerial is determined by knowing two factors; namely its inductance and capacity. These are determined either by calculation or actual measurement. In the former case, the dimensions of the antenna must be known and substituted in the following equation:

$$W = 59.6 \sqrt{L \times C}$$

Where:—W=wave lengths in meters
L=inductance in henries
C=capacity in microfarads.

The answer to Question 1 was obtained from a curve which shows the wave length of a four wire antenna, having different altitudes and lengths. The curve was plotted from Dr. Austin's formulae and is quite exact.

TRANSFORMER ON PULSATING CURRENT.

(648.) Roland S. Stroup, Oklahoma, wants to know:

Q. 1. If he can use a one-half K.W. transformer-coil and Gernsback electrolytic interrupter to good advantage on a pulsating current, due to irregular speed of generator, with a maximum of 110 volts?

A. 1. You should have no trouble in operating your one-half K.W. transformer-coil with this interrupter on the pulsating current. A little patience in adjusting the interrupter will possibly be required before obtaining the maximum results. The current obtained at the secondary terminals will be alternating. If the transformer is built efficiently, it can be operated directly by the pulsating current without the use of the interrupter. In the latter case a suitable resistance or impedance should be inserted in the primary circuit for controlling the amount of current consumed.

Q. 2. Would the above mentioned apparatus, connected to a 200-foot checker-board aerial, be suitable to transmit 50-75 miles? The aerial will be 58 feet high at one end and 30 feet at the other.

A. 2. Under favorable weather conditions and with a properly tuned oscillating circuit you should cover the distance you mention.

CONDENSER.

(649.) R. J. Liedel, Providence, Rhode Island, inquires:

Q. 1. If a condenser will be just as efficient when placed in hot wax and allowed to cool so as to form a solid block with condenser inside, compared to a condenser immersed in oil.

A. 1. The condenser immersed in oil is more efficient for the simple reason that when the molten wax is poured into the mould in which the condenser is placed a certain amount of air is drawn in with the wax, thus producing air pockets which reduce the insulating qualities of the whole, and if the condenser is connected to a high-tension source it is liable to break down at the point where there is an air bubble. For this reason it is advisable to place capacity units in oil instead of in wax. The well-known block condensers which are sold on the market are made thoroughly efficient by forcing the insulating compound into a vacuum chamber in which the condenser is inserted.

Q. 2. Which aerial would you advise for a ¼ K.W. transmitting set—an inverted "L" or a checker-board?

A. 2. An inverted "L."

Q. 3. Would a rotary gap be more efficient if it was encased and air pumped into the case to form a higher pressure?

A. 3. The latter would be more efficient for larger power; the former for low power sets, such as one-sixth to one K.W.

LOADING COIL.

(650.) C. E. S., Minnesota, wishes to know:

Q. 1. How to construct a receiving condenser of about .0005 m.f. capacity.

A. 1. The condenser should be made of 2 sheets of tinfoil, each of which should measure 1x3 inches, properly insulated by 5 mil paraffine paper. This is the theoretical capacity. The size should be about doubled as the paper will not lie perfectly flat.

Q. 2. How to construct a loading coil to increase the wave length to 10,000 meters, with a tuning coil, 4,000 meters and a 75 foot aerial 50 feet high.

A. 2. The winding core should be 24 inches long by 6 inches in diameter and fully wound with No. 24 B. & S. copper magnet wire.

BATTERY QUERY.

(651.) J. G. McKlane, Long Island City, asks:

Q. 1. Where can I obtain a battery yielding 10 volts and 10 amperes?

A. 1. You can obtain this battery from any dealer in storage batteries. We would advise you to refer to our advertising columns for manufacturers of batteries and if you write to them they will be pleased to quote you prices.

Q. 2. What is the pressure of the ocean at the following depths: 15 feet, 20 feet, 25 feet?

A. 2. At 15 feet the pressure is about 6.21 pounds, at 20 feet, 8.28 pounds, and at 25 feet, 10.35 pounds per square inch.

Q. 3. Which do you think the most sensitive of the following detectors: de Forest Audion, Audio-Tron, Electron Relay, Radioson, Crystaloi, Tel-Radion?

A. 3. The first three are about alike as regards sensitiveness. The three latter are listed in their correct order of sensitivity.

TIGHT AND LOOSE COUPLING.

(652.) Harold Olsen, Berkeley, California, asks:

Q. 1. What is the essential difference between loose coupling and tight coupling?

A. 1. In the former the energy transformed between the primary and secondary is reduced by the greater separation of the coils, while in the latter it is increased owing to the closeness of the coils. Tight coupling usually involves the employment of an auto-transformer or single coil.

Q. 2. Give composition of an enamel well suited for insulating copper wire and to give a flexible instead of hard brittle covering.

A. 2. We regret to say that we cannot give the composition formula for coating copper wire with enamel, as these are kept confidential by the companies. We would refer you to the September, 1915, issue of this journal, wherein appears an article entitled *Enameled Magnet Wire, Its Properties and Manufacture* by L. Earl Deane, Briefly stated the bare copper wire passes from the spool through the enamel tank, which is usually electrically heated. The wire then runs vertically through an oven, where it is baked at the proper temperature. The oven is provided with electric fans to maintain the temperature even. This process is repeated five times, five coats on a wire, even down to the number 40 B. & S. gauge. Each coat of enamel is baked hard separately before the next coat

(Continued on page 516)

BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page 487*)

were when the Martian waterways theory was first expounded by Professor Percival Lowell. Lowell, of course, was right when he stated that the Martian Canals were immense artificial waterways, crisscrossing the face of the thirsting planet. As there is practically no rain on Mars, Lowell reasoned correctly that the canals brought the waters from the melting Arctic snow-caps, to the temperate as well as the tropical zones, thus furnishing the planet with its only possible water supply. During one season the waters would move from North to South, during the next season from South to North. Your mundane scientists had no fault to find with this theory, but what they could not reconcile with their feeble intelligence was the tremendous dimensions of these artificial waterways.

How could any living creatures, no matter how strong physically, build canals 2,000 to 3,500 miles long and from six to twenty miles wide? And not only one such gigantic canal, but hundreds of them! Such engineering feats surpassed all bounds of human understanding. It was simply impossible. Some of your scientists, I well remember, even set up intricate calculations demonstrating that it would take thousands of years to construct such brobdingnagian canals, if dug by an army of shovelers! Another demonstrated to his entire satisfaction, that to dig a water channel 3,000 miles long and twenty miles wide, using 5,000 of the monster Panama Canal pattern steam shovels, would require at least 500 years of uninterrupted effort!

I must admit, that when I first read those figures on earth, I was much impressed and began myself to doubt Lowell's theory. But you see, the great trouble with us humans is that we always compare everything to our existing means, never thinking what superior intelligence might accomplish with means unknown to us. Everything is termed impossible because it is not understood at once.

Necessity is the mother of invention on Mars as well as on earth. If a great and ancient people of a highly advanced civilization see death staring them in the face because of the rapidly dwindling water supply, you may rest assured that such a people will employ its best talent towards warding off such disaster in the face of insurmountable difficulties, even in the face of inexorable nature.

I have since satisfied myself that the Martians are not going to die of thirst for centuries to come. I have also noted with satisfaction how puny your most important engineering feats are, such as the Panama Canal, when compared to a Martian waterway. When I think of your little steam-shovels which I called monsters while on earth, I am convulsed with laughter. They seem so ridiculous, so childlike after what I saw yesterday; a child's tin train, standing in front of one of your "Twentieth Century" fliers, could not be more foolish by comparison.

You see the trouble with your scientists and others was, they never considered that great canals could be dug quite nicely without shovels and steam engines. They never thought of it, because they had never heard of it, hence it was, of course, impossible. You have probably seen an oxy-hydrogen flame at work, cutting through a solid bar of steel as if it had been butter. Well, this is what my first impression was when I saw a new canal under construction yesterday.

The Planet Governor, our august host, after we had managed to make clear our wish, conducted us in one of his gravitational flyers towards the site of the new canal. It was explained to us that this new waterway was to be only a "small' lateral affair, "but" 600 miles long and four miles wide, connecting two of the larger canals together. This particular canal was to open up new fertile territory through an existing part of a desert, by supplying the lands along its banks with water.

Floating at a height of about 3,000 feet we observed miles and miles of the new, already-completed, but as yet waterless, canal stretching to the horizon. The canal was perfectly straight as if laid out with rule and pencil.

In front and below us we saw the strange agency that "dug" the canal with a rapidity that was as disconcerting as it was uncanny. Imagine immense metal latticed towers over one thousand feet high rolling forward on wide colossal wheels. And from the top of these towers you observe bursting forth a broad purple electro-chemical emanation ray plying on the ground below in front of it. This ray, which has the property of disintegrating the ground by breaking up atoms of the desert sands, has immense inherent powers. The ground, rocks, sands, etc., everything "melts" before it, as snow goes up in steam before an oxyhydrogen flame.

Of course, this ray is not hot in itself, it simply reduces all objects to their very atoms. It is a sort of atomic volatization effect—the rocks and sand simply vanish into thin air. The wheeled towers which advance at the rate of about fifteen miles an hour, never stop. Their rays cut through the soil steadily and with an astonishing precision. But the rays do not penetrate deeply, their adjustment being such that the depth of the finished canal measures but ten feet. No waterways on Mars are more than twenty-five feet deep, for they are used solely for the transportation of water, no ships or vessels of any kind ever appearing on a canal.

Of course, you will ask immediately, "What becomes of the 'excavated' material? Though 'volatilized' atomically, it still must needs exist for in Nature nothing is ever lost."

The answer is simple. Take water for example. If you decompose a gallon of it by electrolysis, it vanishes completely. Naturally it has not become lost, it has merely been transformed into its chemical equivalents, i.e., two gases—oxygen and hydrogen.

While you on earth know how to split up the water in its two equivalent gases by means of electricity, you have not as yet succeeded in disintegrating water by breaking up its atoms. Decomposing water, you see, is but a crude mechanical process. It is as if you had cut an ear of corn into two portions by means of a knife; in this operation you have not cut in two all the hundreds of kernels (atoms). This, of course, is but a homely analogy, but it serves quite well to illustrate the idea.

In breaking it up into atoms, matter is transformed into energy, consequently nothing is lost. On Mars the secret of this accomplishment is the purple electro-chemical emanation rays, an invention several hundred years old on this planet.

Upon touching the ground or sands the rays instantly break up the atoms of the minerals, which explode with a terrific hissing noise, like escaping steam. The heat liberated by this process is so enormous that at the point of the ray's deepest penetration, the sand or ground is fused to a lava-like substance impervious to water which the Martians termed Tos. That this is so is indeed fortunate. For, if the Martians were merely employing a simple excavating process, they would have to water-proof the entire canal, to prevent the waters from seeping into the sands. The reason for this is very obvious.

(*Continued on page 539*)

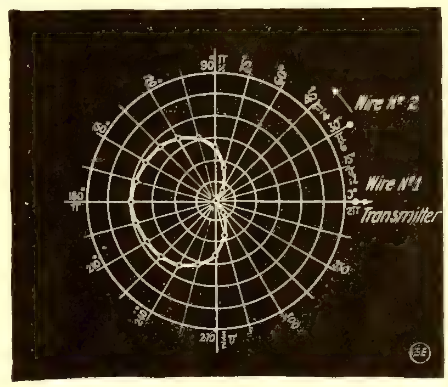
MEETING OF THE INSTITUTE OF RADIO ENGINEERS.

At the recent meeting of the Institute of Radio Engineers held at the Societies' Building on September sixth, two very interesting papers were presented—one on Ground Antennae, given by Leonard F. Fuller, chief electrical engineer of the Federal Telegraph Co., and which gave full details of some of the experiments conducted in 1913 by his company, under his direction.

These experiments were of a somewhat unusual nature, inasmuch as polar graphs were used for plotting the current values registered at the receiving station. A typical curve showing the intensity of received signals is shown in Fig. 1. This shows the relation of two wires, one of which was fixed, while the other rotated about an axis of 360 degrees. At the receiving station a sensitive galvanometer was used for indicating current values received at that station. These currents were plotted in accordance with the rotation of the rotating wire about the 360 degrees.

Several curves were plotted with different lengths of wire and the particular one here shown gives a cardioid or heart-shaped curve. It will be seen that when the wire was pointing 180 degrees *away* from the transmitter, that maximum current values were received at the receiving station.

Several other graphs were illustrated together with experimental data, some of



Graphical Curve of Activity for a Ground Antenna as described by L. F. Fuller of the Federal Telegraph Co.

which has already been published in previous issues of THE ELECTRICAL EXPERIMENTER.

The second paper was presented by Prof. Charles A. Culver of Beloit's College, Cambridge, Mass., which dealt with the subject of Radiation from Horizontal Antennae. He spoke particularly of the special antenna constructed at the Cruft's High Tension Laboratory at Harvard University. The antenna was designed in such a way that it pointed to several different places at each of which receiving instruments were installed.

Data was given for a transmitter operating on 1.9 K.W. and various details showing the amount of current radiated from the antenna and the audibility factor attained at the receiving station. Several tests were conducted and it has been found that an ordinary straight antenna radiating a current of 4.7 amperes to the antenna gave a maximum audibility of 37+. This experiment was conducted at 9.30 a.m.

Both papers were followed by lengthy discussions by Prof. J. Zenneck, Dr. Lee de Forest, Mr. Lockwood, Mr. Armstrong and others.

The problem of *radiation resistance* of an antenna is still in its infancy and there is considerable research work to be carried out in this direction. There is no doubt that the various radio amateurs can perform useful experiments along this line.

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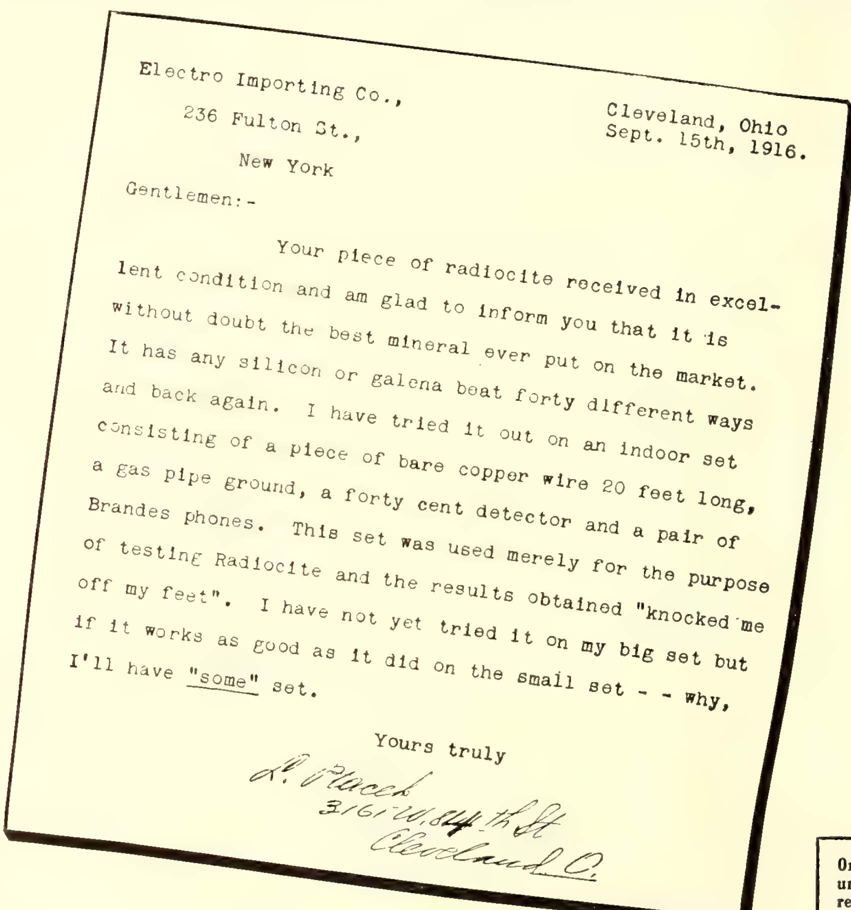

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Name..

Address..

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QUESTION BOX.

(*Continued from page 512*)

is applied. The finished wire is run off on to spools.

Q. 3. Is the Trust holding back the supply of copper, or is there not enough copper to supply the demand for it?

A. 3. There is not enough copper to supply the enormous demand, hence the increase in price.

BALSILLIE RADIO SYSTEM.

(653.) J. Hanson, Washington, D.C., asks for:

Q. 1. A diagram of connection of the Balsillie system.

A. 1. The diagram gives connections: The current of frequency 350 cycles is taken from the rotary converter A. B is a choke coil. The transformer C, D, is an open magnetic circuit transformer. The gap E is air-cooled with the object of preventing the formation of an arc. F, G, and H are condensers. J and I are choke coils. It is a *shock* excitation system.

Q. 2. What do you consider the best means of communication, by using either the damped or undamped waves?

A. 2. For short range transmission, the damped transmitter is far more efficient as explained in one of our previous issues. When employing a sustained wave apparatus the current is being continually generated and emitted by the antenna and is interrupted only when signals are sent out.

Q. 3. Does the formula for the frequency of an ordinary oscillating circuit cover the frequency of the Lepel system?

A. 3. No. It has been found by Naysmith

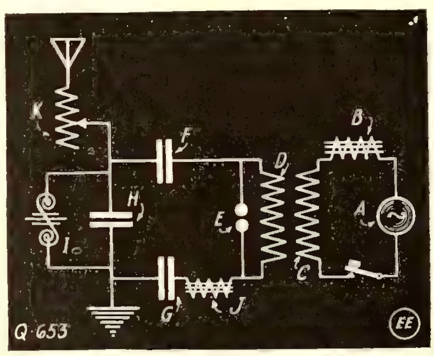


Diagram of Connections in the Balsillie Radio System.

that the Lepel circuit obeyed the following equation:

$$N = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{I^2d^2}{4L^2I^2}}$$

where:—N=frequency
l=length of arc
d=constant depending on the metal of the gap and the gap atmosphere; I is the arc current and L C is the product of inductance and capacity in the oscillating circuit.

AERIAL QUESTION.

(654.) William Walker, Williamsburg, Pennsylvania, asks:

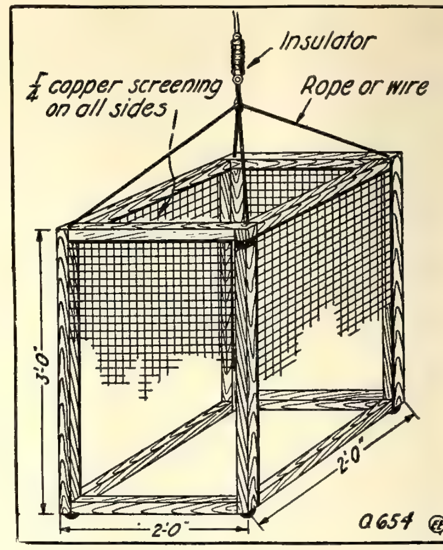
Q. 1. Would an aerial of the type shown in the diagram be efficient, and if not, why?

A. 1. The antenna will prove satisfactory for short range work.

Q. 2. What is the wave length of my aerial, which is composed of three strands of No. 18 B. & S. gauge copper wire, each 150 feet long and having a mean height of 30 feet?

A. 2. 435 meters.

Q. 3. What is the wave length of my tuning coil wound on a tube 13 inches long and 2¾ inches in diameter, wound for 11¼ inches of its length with No. 23 B. & S. gauge enameled magnet wire, and provided with a single slider? Would it increase the



Type of Radio Antenna Suitable for Short-Range Work.

efficiency of my set to add another slider?

A. 3. 560 meters. It would increase your tuning efficiency considerably by adding another slider.

SLATE AS AN INSULATOR.

(655.) Charles W. Squires, Port Jefferson, New York, inquires:

Q. 1. What is the efficiency of the compressed air gap as compared with a straight and other gaps?

A. 1. The compressed air gap is more efficient than the ordinary straight open gap.

Q. 2. Is slate a good insulator? A prominent manufacturer of electrical goods states that it is not, at least not for currents above 1,000 volts. At such a tension slate begins to "leak."

A. 2. Slate as an insulator is very poor. However, it is extensively used on low voltage circuits not exceeding 300 to 500 volts potential.

FREQUENCY CHANGER.

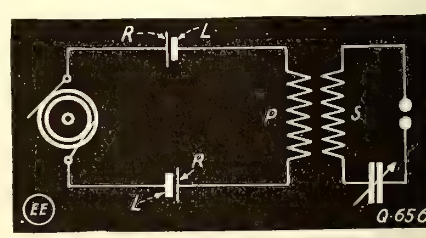
(656.) P. Poulson, Atlanta, Georgia, wishes to know:

Q. 1. What is the inductance of a choke coil having 400 turns, the iron core being 60 cms. long and of 300 sq. cms. cross-sectional area? Kindly tell me how you obtain the result.

A. 1. The equation for the inductance of a choke coil is:

$$L = \frac{1.26\,N^2uA}{10^8\,l}$$

where:—N=number of turns
u=permeability of iron core; in this case we will assume it to be 1,500.



Using two Electrolytic Rectifier Cells to Double the Frequency in a Radio Transmitter.

A=mean cross-section of core in sq. cms.
l=length of core in centimeters.
Substituting the values given the problem,

(*Continued on page 518*)

THE ELECTRO-SET CO.

THE BIG SQUARE SUPPLY HOUSE FOR EXPERIMENTERS

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From Arthur R. Birkibs, Bronxville, N. Y.
Dear Sirs: You certainly sent the goods very quickly. The Galena and silicon are the most sensitive minerals I ever chanced to use. They are sensitive all over. Your catalogue has the most complete line of wireless and electrical goods I ever saw.

From Forrest Adams, Shawnee, Okla.
Gentlemen: Received your catalogue and it sure has some values in it. The raise in prices are lower than in other catalogue raises.

From Wm. Howard Garkener, Brandon, Man., Can.
Gentlemen: I have received the Tele-Set and the Boy Scout Secret Service Writing Outfit. The writing outfit is something to talk about. It works great and so does the Tele-Set.

From George Bilgam, New York City.
Gentlemen: As to your N. A. A. tested Galena: It cannot be praised highly enough. There is not a "dead" spot on the entire crystal and can assure you that I am recommending it to my friends.

From H. F. Buckingham, Monroeville, Ohio.
Gentlemen: I purchased one of your one-half-inch spark coils, and it will give a three-fourth inch spark with ease, and have sent ten miles with same.

From John Doering, Rock Island, Ill.
Gentlemen: I am writing you this letter to thank you for the kind attention you showed. I received the package containing the brass rod and other material yesterday. By your attention in this matter you have made me a sincere friend and a booster for your company. To show you the value of a good recommendation, I will say that it was the recommendation from a fellow-experimenter that induced me to send this order of mine to you. So I will recommend your company to all my friends.

From Wesley Gibbs, Rochester, N. Y.
Dear Sirs: In the morning mail of June 29th I received your postal saying that the articles which I ordered had been sent. I received them in the afternoon. This was the promptest shipment I have ever had. I am pleased with the order.

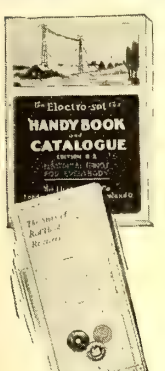
From Albert A. Munch, Pittsburg, Pa.
Gentlemen: Just a few lines to express my gratitude for the way you handled my order. I have dealt with quite a few wireless concerns, but only one has come up to your standard, and none above it. I wrote you a card on receipt of the Insulators and Guy Wire asking you to rush the remainder of the shipment through and I was astounded when I found the Wire and the other Insulator upon my arrival home. I am sure if the amateurs would place one order with you, they would be your steady customers. Thanking you again for Electro-Set Service, and hoping to have an order for you in the near future, I am.

From Leonard Bambauer, Erie, Pa.
Gentlemen: I sent for a receiver last Monday and received it last Thursday. I found same very satisfactory and I indorse your goods very highly.

From Richard Klerk, Jr., New York City.
Dear Sirs: I will recommend your company in every way possible for its promptness and efficiency of material.

HAVE YOU TRIED THE ELECTRO-SET CO. YET?

HERE'S THAT BIG



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NOTE: Do not confuse this offer with our regular Arlington Tested Individually Packed Galena at 25c postpaid. Arlington Tested Galena will be sent if requested upon receipt of 25c in stamps or coin. *Arlington Galena is individually tested for extreme distances and is ultra-super-sensitive.*

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MAILING AND EXPRESS ROOM


CATALOG DEPARTMENT


A VIEW OF OUR RETAIL STORE


MAIL ORDER OFFICES


VIEW OF ONE OF OUR STOCKROOMS

QUESTION BOX.

(*Continued from page 516*)

we get:—

$$L = \frac{1.26 \times (400)^2 \times 1500 \times 300}{10^8 \times 60}$$

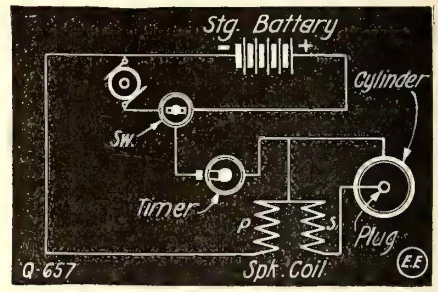
Hence L=15.1 henries.

Q. 2. How would you connect two lead-aluminum, electrolytic rectifiers with a transformer for doubling the fundamental frequency supplying the transformer?

A. 2. The diagram gives the connections you desire. It should be remembered that the oscillating circuit must be tuned to twice the fundamental. so as to bring the primary and secondary into a resonant condition.

Q. 3. What efficiency would I obtain from such an arrangement?

A. 3. About 45 per cent at the most.



Hook-Up for Jump Spark Ignition Coil on Gasolene Engine, Operating on Either Dynamo or Storage Battery.

IGNITION COIL CONNECTIONS.

(657.) L. Kintoes, Sitka, Alaska, wishes:

Q. 1. A wiring diagram showing how a dynamo and storage battery are connected for ignition.

A. 1. The diagram below shows the connections.

Q. 2. Why is oil employed on top of the solution of a copper oxide primary battery?

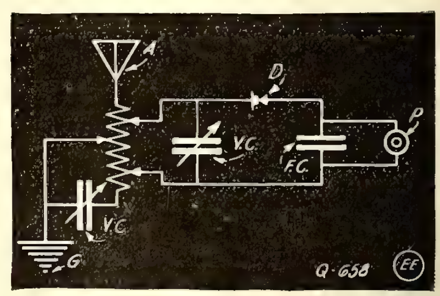
A. 2. The oil keeps outside dirt particles from entering the active electrolyte and prevents creeping of the battery salts. All copper oxide batteries use caustic potash, or caustic soda as an electrolyte. If the oil did not shut it off from the atmosphere, the solution would spoil in a few hours.

STEP-DOWN TRANSFORMER DATA.

(658.) Clarke Olney, East Cleveland, Ohio, asks:

Q. 1. Is there any way of hooking up two or three single or double slide tuning coils so as to make them as efficient as a loose coupler?

A. 1. The diagram herewith shows how to connect a three slide tuner so as to give results equal to that of a loose coupler as far as tuning is concerned.



Efficient Connection for Three Slide Tuning Coil in Radio Receiving Circuit.

Q. 2. If so, would the wave length of the above be the combined wave length of the included coils?

A. 2. Yes. The wave length would depend also upon the size of the coils and upon the shunt capacities therein.

Q. 3. Please give specifications for a small closed core transformer to reduce 110 volts A.C. to about 8 or 10 volts A.C.

A. 3. The primary winding should consist of 500 turns of No. 36 insulated magnet wire. The secondary is wound with 40 turns of No. 16 wire. The iron circuit is made of laminated iron sheets of No. 21 B. & S. gauge and it should measure 5"x3" outside. The windings should be properly insulated from the core.

MICROPHONE.

(659.) R. M. Jenkin, Wellington, New Zealand, wishes to know:

Q. 1. What sort of microphone and relay would be most suitable for working surprise stunts, such as opening a door by merely speaking to it. Also where he could obtain such an instrument and the price.

A. 1. In this kind of work it is necessary to employ a detectaphone transmitter. This can be obtained from the Micropho-Detector Co., 119 Nassau Street, New York City.

COAL TAR.

660.) P. Fisher, New York, N.Y., asks:

Q. 1. What are the operations for making coal tar?

A. 1. Due to lack of space, it is impossible for us to enter into details as to the making of coal tar. The usual procedure is to place into a closed crucible a quantity of soft coal and it is heated until the coal tar starts to flow. This is drained from the bottom of the crucible by a suitable valve cock. The cover of the receptacle is fitted with an opening for permitting the gases to escape. These are very important factors, as most of the gasoline, benzine, naptha, etc., is removed from the gases after they have been properly condensed.

SIZE OF CONDUCTORS VS. VOLTAGE.

(661.) P. Hallweck, San Francisco, California, wishes to know:

Q. 1. What is the relation between the cross-sectional area of electrical conductors and the voltage?

A. 1. The cross-sectional area of a given conductor varies inversely with the voltage.

Q. 2. Is there any advantage in employing an alternating current arc for radiotelephony instead of a direct current arc?

A. 2. Very little can be said about the alternating current arc as a generator for sustained waves, as but little has been done in this direction. It may, however, be stated that the arc starts oscillating much more efficiently, but we cannot tell off hand as to whether it proves to be more so when based on high power units. The subject is still open for research.

Q. 3. Describe the rotary field type of induction instrument.

A. 3. The parts are arranged similar to those of watt meters, the necessary split phase being produced by dividing the current into two circuits; one of which is inductive and the other non-inductive.

MOTOR QUERIES.

(662.) L. Jackson, Indiana, wants to know:

Q. 1. Some of the advantages and disadvantages of series motors.

A. 1. They are easily started, even under heavy loads. The winding is cheaper than the other types and the speed is nearer constant than shunt motors when operated on constant current circuits. When used on constant pressure circuits such as those employed for incandescent lighting, the speed will depend on the load. On no load they tend to race and will, if not watched, tear themselves to pieces.

Q. 2. In the operation of a motor what is the nature of the reverse E.M.F. (counter electromotive force)?

A. 2. It is proportional to the velocity of rotation, the strength of the magnets and to the number and arrangement of the wires on the armature; that is, the reverse voltage depends on the rate at which the lines of force are cut.

Q. 3. How may the rotation of a motor be reversed?

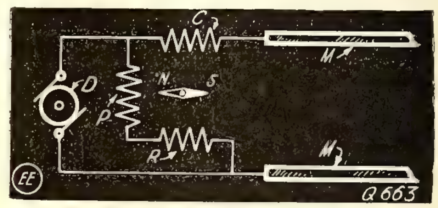
A. 3. By reversing either the current through the fields, or the current through the armature.

OHMMETER.

(663.) Pondy Elk, Pennsylvania, writes:

Q. 1. What is an ohmmeter?

A. 1. It is an instrument for measuring resistances directly where it is desirable to test with a high voltage. It consists of two parts, namely, a small hand dynamo capable of generating 100 volts or more, and the instrument proper. The latter has two coils mounted at right angles to each other and a magnetic needle, which takes a certain position between the two coils, according to the relative currents in the coils. One coil is connected between the dynamo and one terminal of the circuit whose resistance is to be measured. The other coil is connected in series with a high resistance inside the instrument so as to form a shunt across the main circuit, as shown in the figure. When the dynamo is operated, the current divides, part going through the coil C and then through the main circuit, whose resistance is to be measured, while the remainder goes through the coil P and the high resistance R. The currents through the two coils are inversely proportional to the resistances in their circuits



Circuits of Direct Reading Ohmmeter of the "Megger" Type.

since the same voltage is applied to both, and therefore they attract the needle, correspondingly. For a given voltage of the dynamo, the attraction of the coil P is constant, while the attraction of coil C becomes greater as the resistance in the main line becomes less. The pointer attached to the needle will, therefore, move towards C, as the resistance in the line becomes less and the scale may be divided to indicate the resistance in the main circuit.

Q. 2. For what ranges of resistance is the ohmmeter suitable?

A. 2. It will measure resistances from about 5 megohms (5,000,000 ohms) down to about 1,000 ohms. It is suitable in measuring the resistances of cable insulation, etc., besides many other things.

NAVY COUPLER.

(664.) Sigmund Schmeltzer, New York, wants:

Q. 1. Information on how to build the Navy type loose coupler.

A. 1. We would refer you to the September, 1915, issue of The Electrical Experimenter for information concerning the construction of a Navy type inductive coupler. Full details are there given on a separate blue-print supplement showing its construction. If you do not possess this copy, we can supply you with one for fifteen cents postpaid.

Q. 2. I would like to know what instruments to use in order to receive NAA. I have an aerial sixty feet long, composed of four wires, separated a foot and a half

(*Continued on page 522*)

SEE OUR BIG SUBSCRIPTION OFFERS ON PAGES 541 AND 542

QUESTION BOX.

(*Continued from page 520*)

apart. My aerial is about seventy-five feet high.

A. 2. The following instruments will be required: A 3,000 meter inductive coupler, loading coil, 2 variable condensers, fixed condenser, crystal or vacuum detector; if former we advise you to employ Radiocite for the crystal and a pair of 2,000 ohm telephone receivers.

A. C. QUERIES.

(665.) A. Goldman, Richmond, Virginia, wants to know:

Q. 1. How can the frequency of an alternating current be calculated?

A. 1. The frequency in cycles per second equals one-half the number of field poles on the alternator, multiplied by the number of revolutions per second of the rotor.

Q. 2. How are two phase currents obtained?

A. 2. One method is by the use of four collecting rings connected with four points on a direct current commutator; one pair being connected to points directly under brushes of opposite polarity; the other pair being connected to points midway between these. Another method is to couple the armature shafts of two similar alternator armatures together so that the electro-motive-force of one is a maximum at the same instant that the E.M.F. of the other is at the zero. The more usual method for commercial work is to use a regular 2-phase alternator, wound for the purpose and having either four or three slip rings.

Q. 3. What prevents an enormous current from passing through the primary coil of a transformer and burning it out?

A. 3. The small alternating current that passes through the primary coil magnetizes the iron core, first in one direction and then in the other. This rapid magnetization and demagnetization means that the number of magnetic lines of force threading through the iron core inside the coils is continually changing. Viewed from a slightly different standpoint, it means that lines of magnetic force are continually crossing the coils, or that the coils are continually being cut by the lines of force. The result is the same from either standpoint, the changing magnetizations of the iron core causing the generation of E.M.F. in the coils surrounding the iron. The E.M.F. thus induced in the secondary coil causes a current to flow in the secondary circuit. Likewise the E.M.F. similarly induced in the primary coil tends to send current through the primary circuit in opposition to the original current. Thus the E.M.F. induced in the primary coil acts as a counter electro-motive-force and opposing the impressed voltage on the primary circuit, thus holding back the primary current.

ACTION OF WIRELESS WAVES.

Ever since the extensive commercial employment of wireless telegraphy, there have been many who believe that the powerful Hertzian waves seriously affect organic life. In fact, some have even suggested that laws or regulations should be enacted to protect organic life against wireless waves. With a view to determining the extent and nature of the radio waves' influence on organic life and climate, Dr. C. Abel-Musgrave recently asked several questions on the subject to be answered by a number of prominent scientists. The summary of their answers was that wireless waves have no influence on organic life, nor do they alter climatic conditions, although it is true that certain electrical stresses are capable of accelerating rainfalls.

Electric flat irons are rapidly replacing hand and gas irons in English tailor shops.

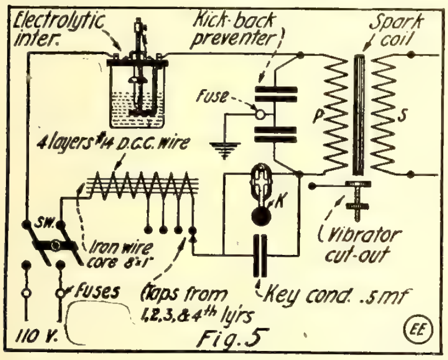
THE HOW AND WHY OF RADIO APPARATUS.

(*Continued from page 493*)

on reflection it will be evident that when the primary circuit is open the primary current magnetic flux is collapsing and in doing so the flux lines are caused to cut the secondary turns in a direction opposite to that at *make* of the circuit. Figs. 2 and 3 will make this quite clear, as the expanding and contracting lines of force are clearly shown therein.

From this discussion, as well as from the illustration given in Fig. 4, it becomes evident that in the ordinary induction coil, in the medical coil for instance, a pulsating direct current passing through the primary winding is transformed into an unsymmetrical, alternating current in the secondary winding; the half waves of which are not harmonious. In the spark coil, however, where the secondary potential is sufficient to create a disruptive spark, the direct current passing in the primary is transformed into an unsymmetrical, alternating current in the secondary only, when the spark gap is sufficiently short to allow the weaker, or inverse half wave B, of the current to jump it. If the gap is too long for the B half wave to leap across it, then the secondary current is practically a undirectional one.

It is possible to test the polarity of the secondary terminals by means of pole test paper or also a standard, liquid polarity indicator may be utilized. If two pieces of fine iron wire are connected to the secondary terminals of the spark coil, one of them will become very hot and the other will remain cold; the cold one being the positive terminal of the coil.



Proper Connections for Small Spark Coil with Electrolytic Interrupter on 110-Volt Circuit.

As shown by the oscillogram Fig 4, which is that for a small spark coil fitted with a vibrator shunt condenser, the duration of the primary current at the *break* of the interrupter is quite short. The duration of this portion of the primary current is kept as short as possible, and aided in so doing, to a large extent, by the condenser shunted across the vibrator. This condenser absorbs the extra or self-induced current of the primary, which would otherwise unduly prolong the demagnetization of the iron core. The general wave form of the primary current, and sensibly also its potential, is similar to that shown at Fig. 4. When the interrupter closes the primary circuit, the primary current rises slowly to a maximum and at the rupture at the interrupter, the primary current and potential fall quite rapidly to zero. The quicker the break of the interrupter and the faster the demagnetization of the iron core, the more pronounced the intensity or potential of the secondary induced wave, A. This is shown graphically, and in a striking manner, by the oscillogram.

Small spark coils may be operated in the regular way from A.C. step-down transformers. Where 110 volts A.C. or D.C. is available it is a good idea to operate the spark coil with an electrolytic interrupter;

see Fig. 5. Small coils, such as the ½ or 1 inch variety, should not be hooked up direct to 110 volt circuits, but should have a suitable choke coil in series with the primary winding and the electrolytic interrupter. All such installations should, no matter how small, be equipped with a kick-back preventer of approved form. It is required in all cases by the Fire Underwriter's rules governing radio installations operating on commercial light and power circuits.

THE SPERRY 1,280,000,000 C.P. SEARCHLIGHT THROWS BEAM OVER 50 MILES.

(Continued from page 484)

crank carrying a crown gear, which engages a gear on the vertical shaft is used to rotate the carbon by hand if necessary.

The positive feed is operated by thermostatic control of powerful solenoids through the vertical shaft. The thermostat is mounted on the drum and so arranged that when the positive carbon burns out of the focal point of the mirror the light from its crater is brought on to the thermostat, causing feed of the positive carbon until the focal point is again reached. This automatic control of the positive carbon is also supplemented by hand control.

The feed of the negative carbon is controlled by a solenoid connected directly across the arc and moves the carbon in the proper direction as the voltage rises or falls. The automatic feed of the negative carbon is also supplemented by hand control. A striking solenoid moves the entire negative holder back the proper arc length on striking of the arc.

The entire negative carriage can be turned on the right to permit new negative carbons to be inserted; when so turned, the grip on the carbon is released slightly, permitting a new carbon to be slipped in easily.

The operation of the Sperry lamp is very steady and requires but very little attention after the simple adjustments for length of the arc, speed of rotation of the positive carbon, and the feeding of the carbons have been made. The positive carbon is inserted into the holder by slowly rotating it and pushing it forward at the same time.

A rheostat is used in series with the arc, adjusted so as to get a voltage across the arc of about 75 volts.

A very important advance in this work has been in the manufacture in this country of carbons suitable for such searchlight arcs. Formerly the only source of supply of carbons suitable for these results was Germany, but after many months of research work it is now possible to manufacture superior carbons for this purpose in this country.

Searchlights of 24, 30 and 60-inch diameter of the Sperry type are being built. In addition, the Sperry lamps are being installed in old searchlights replacing the old form of arc.

EXPERIMENTAL CHEMISTRY.

(Continued from page 502)

placed on top of it, to prevent it from overturning.]

[Note:—The Manganese Dioxide was used with the Potassium Chlorate as a catalytic agent. The properties of this compound were not changed, this substance being used to help the reaction along.]

The reaction which took place in the preparation of oxygen from Potassium Chlorate and Manganese Dioxide, was as follows: (A)

$$\underset{\text{[Potassium Chlorate]}}{2KClO_3} + \underset{\text{[Manganese Dioxide]}}{MnO_2} = \underset{\text{[Potassium Chloride]}}{2KCl} + \underset{\text{[Manganese Dioxide]}}{MnO_2} + \underset{\text{[Oxygen]}}{3O_2}$$

Another method of writing this equation is as follows:

(B) $2KClO_3 = 2KCl + 3O_2$
[Potassium Chlorate] = [Potassium Chloride] + [Oxygen]

It is shown by the equation (A) that the Manganese Dioxide was not altered by the reaction.

ACTION OF BURNING WOOD IN OXYGEN.

Experiment No. 17—

Take one of the bottles of Oxygen, and while the glass plate is in position over the mouth, slide the plate slightly to one side of the bottle, just enough to admit a small piece of wood, as round as a match. Light this thin piece of wood, and while there is still a glow on the tip [*but no flame*], thrust it into the bottle, and notice the result. Try this over two or three times. Cover the bottle with a glass plate after burning the splint in it.

The following experiment to test for the product of wood burning in oxygen can be made.

Experiment No. 18—

Pour into the bottle about 10 or 15 cc., of Limewater [Calcium Hydroxide] [$Ca[OH]_2$], and close the mouth of the bottle with either a cork, or the palm of your hand, then shake the contents, and pour into a test tube for examination.

ACTION OF CHARCOAL BURNING IN OXYGEN.

Experiment No. 19—

Obtain a small piece of charcoal [about ½x½ inch] and place in a combustion spoon, or forceps, and hold in the flame of the Bunsen burner, until it has a bright glow. Then thrust it into the Oxygen [a different bottle than used in Experiment No. 17 or 18] in the same manner as Experiment No. 17. Notice what action has taken place.

ACTION OF MAGNESIUM WITH OXYGEN.

Experiment No. 20—

Take another bottle of Oxygen, and set it on the work table ready for instant use, as soon as the magnesium is ignited. Take a piece of Magnesium Ribbon about 1 or 2 inches long, and hold tightly with a pair of forceps as shown in Fig. No. 30-31, then ignite the end of the ribbon, and thrust it immediately in the jar of oxygen. Observe the action which takes place. [Note:—The Magnesium Ribbon must be thrust into the jar as soon as it is lit, otherwise it will burn up before you have a chance to place it in the jar.]

BURNING IRON IN OXYGEN.

Experiment No. 21—

In this experiment a large bottle is required, and about 1 inch of water in the bottom of the bottle to prevent it from breaking.

Have a piece of stranded picture wire about 2 inches long, and hold it with a pair of forceps. Heat the wire to a red glow and dip it while hot, into some powdered sulphur. As soon as the sulphur starts to burn, thrust it into a jar of oxygen in the same manner as in Experiment No. 17, and watch and record any action which takes place. If no change is observed, repeat the operation.

[Note:—It is necessary to use different jars of oxygen, for all the experiments mentioned above. Do not try two or more experiments in the same bottle of oxygen.]

In the foregoing experiments we have burned certain substances in the gas Oxygen. Let us compare the difference in the burning of these substances both in Air and Oxygen.

In the case of the splint of wood, we know that before it was burned in oxygen, it had only a faint glow, almost ready to go out. After it was thrust in the oxygen it immediately burst into flame.

In the case of charcoal, it was similar to

the burning of the splint, namely it burned rapidly in oxygen.

In the case of Magnesium, it might have been hard to distinguish the difference between the glow in and out of the oxygen due to the brightness of the light.

In the case of iron wire, we know that we could not burn it in air. But it burned readily when we plunged it into the oxygen. If we could burn iron in the air as readily as in oxygen, the result to all iron stoves, iron vessels, iron buildings, iron ships, etc., is obvious.

THE COMBINATION OF A SUBSTANCE WITH OXYGEN.

From the experiments performed we know that when a piece of wood burns in oxygen, the wood becomes charred, and a black mass, with different properties, is left in place of the original wood. In Experiment No. 18 we performed a test to find out what the wood formed when burned in oxygen.

Wood, we know, is chiefly Carbon; then the reaction which took place between the wood and oxygen was as follows:

$$C + O = CO_2$$

[Carbon] + [Oxygen] = [Carbon Dioxide]

The product was carbon dioxide [CO_2], which proved its presence by the Limewater Test. The reaction which took place between the Carbon Dioxide and the Limewater was as follows:

$$CO_2 + Ca(OH)_2 = CaCO_3 + H_2O$$

[Carbon Dioxide] + [Limewater] [Calcium Hydroxide] = [Calcium Carbonate] + [Water]

The white precipitate which formed after shaking with limewater, being Calcium Carbonate [$CaCO_3$].

In the case of Magnesium, the product was Magnesium Oxide; the reaction being:

$$Mg + O = MgO$$

[Magnesium] + [Oxygen] = [Magnesium Oxide]

The iron was converted into Iron Tetroxide, the reaction being:

$$3Fe + O_4 = Fe_3O_4$$

[Iron] + [Oxygen] = [Iron Tetroxide]

Thus we find that when a substance burns in oxygen an OXIDE is formed, as shown by:

Wood	=	Carbon Dioxide [CO_2];
Magnesium	=	Magnesium Oxide [MgO];
Iron	=	Iron Tetroxide [Fe_3O_4];
Sulphur	=	Sulphur Dioxide [SO_2];
Phosphorus	=	Phosphorus Pentoxide [P_2O_5];
Zinc	=	Zinc Oxide [ZnO];

CHEMICAL DEFINITIONS.

Catalysis—Catalysis is a chemical action by which a substance exerts a chemical effect, and which undergoes no permanent change itself. The Manganese Dioxide as used together with Potassium Chlorate in the preparation of oxygen, is known as a CATALYTIC AGENT, or CATALIZER; and the process as CATALYSIS.

Combustion—Combustion is a chemical action accompanied by light and heat.

Decompose—To break up into simpler parts.

Decomposition—The act or process of breaking a compound into its constituent parts or elements.

Equation—A Chemical Equation represents symbolically a chemical reaction, the symbols of the new substances formed by the reaction being placed on the right hand, while the symbols of the reacting substances are placed on the left hand. In a chemical equation the number of atoms of each element must be the same on each side of the equation.

An *Oxide* is a compound of oxygen with another element.

Oxidation is the combination of oxygen with a substance.

Slow Oxidation is the combination of oxygen with a substance without noticeable light and heat. The rusting of iron represents Slow Oxidation.

(*Continued on page 528*)

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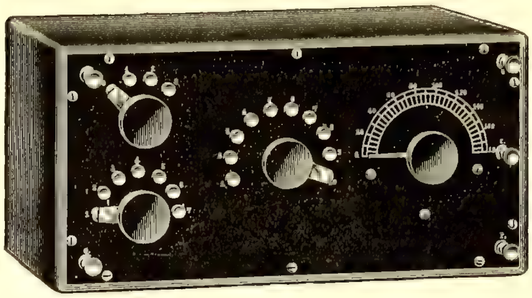

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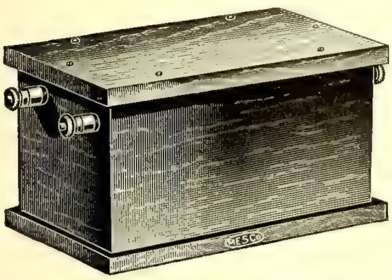

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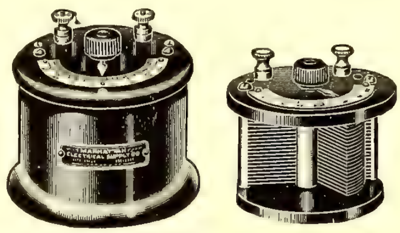

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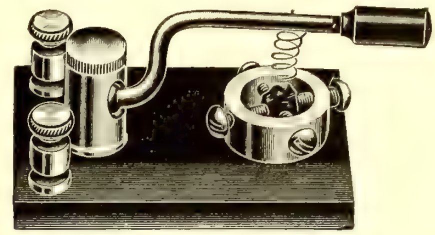

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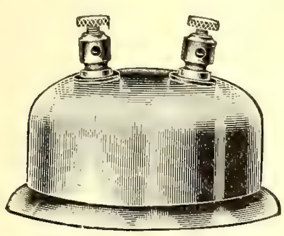

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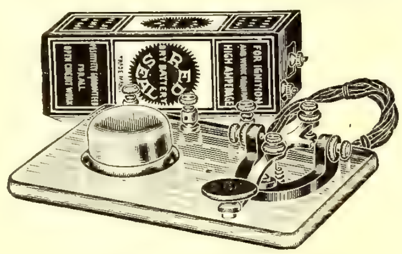

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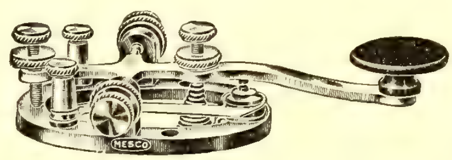

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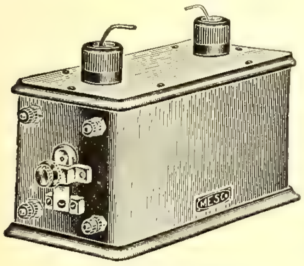

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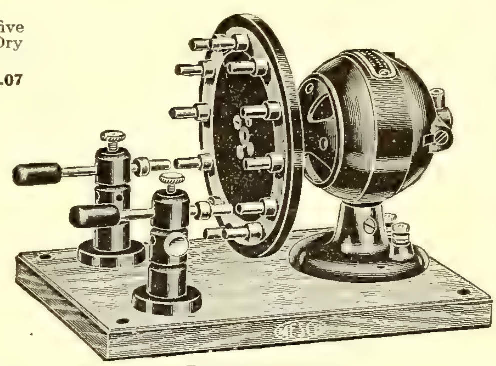

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EXPERIMENTAL CHEMISTRY.

(*Continued from page 526*)

Reaction—A reaction is the chemical change or effect produced by bringing at least two elements or compounds together, whereby one or more new bodies are formed, which may consist either of a gas, liquid, solid, or a mixture of these.

ACTIVITIES OF THE NEW BRITAIN RADIO CLUB.

(*Continued from page 489*)

and at sea. Many evenings when Arlington or some other powerful station is sending, he can lay the receivers on the table, go to bed and still hear them sending. Then when he has had enough he can shunt the 'phones by means of a small switch on the bed.

Mr. Bollerer obtains very good results with his set and hears many amateurs within a radius of 500 miles. He hears a ¼ K.W. set 250 miles away very plainly and a ¾ K.W. set 800 miles away from his station. Within 300 miles his signals can be heard very strongly. Many times he hears Colon, Panama, and Key West, Fla., working. He holds a radio license from the U.S. Government—call 1VH. He is desirous of exchanging photographs of his set with other amateurs.

Mr. Mulvihill's set consists of the following: The receiving set comprises 1,800 meter loose coupler, Holtzer-Cabot receivers and two variable condensers set into the table. There are three detectors used, galena, Crystaloi and an Audion. A wave meter is employed to indicate the wave length of the incoming messages. Two D.T.S.P. switches are used to switch on the desired detector.

The receiving aerial measures 183 feet long and 137 feet high, composed of 2 strands of phosphor bronze wire, spaced 10 feet apart. The sending aerial is 80 feet long and 137 feet high.

The sending instruments include a 1 K.W. transformer, a stationary gap and a rotary gap having a speed of 9,000 R.P.M.; the disk is 6 inches in diameter with 12 plugs. There are also an oscillation transformer, a kick back preventer, a .001 mfd. condenser and two keys.

All the operating switches are mounted on the switchboard in front of the set, which makes it very easy for the operator to handle it. Mr. Mulvihill has been experimenting with a wireless telephone and has succeeded in working it up to a distance of 5 miles. Signals can be heard from NAA, NAR and NAX, with the 'phones 15 feet away. Under good conditions a dis-

tance of 435 miles can be covered with the sending transformer. His call is 1TB.

The radio station owned by Mr. Wesley Parker operates with an aerial 70 feet long, 40 feet high, composed of four strands of No. 14 copper wire, spaced 2 feet apart. The lead-in is of No. 4 copper wire, run to a 600 volt, 100 ampere, lightning switch. From it there runs a No. 4 copper wire to the ground proper.

The receiving set is composed of a loose coupler (single slide) with loading coil, fixed condenser and galena detector, both made by the Wm. J. Duck Co. Further there is a pair of E. I. Co. 2,000 ohm 'phones. A buzzer test circuit operated by a foot type switch on the floor is provided.

The sending apparatus includes a 1-inch Mesco spark coil, J. H. Bunnell key, Murdock spark-gap, and a home-made glass plate condenser, also a helix. Arlington is heard very loud without using the loading coil.

The radio station of Mr. Robert Yuon is described below:

A phosphor bronze four-wire aerial about fifty feet in length with a long lead-in is used. The ground is obtained through a connection to a water pipe.

The receiving set comprises the following: one long wave loose coupler and a loading coil, by means of which he can tune up to 4,000 meters. There are two detectors, one crystal which is used on local stations, and one Audion which is used on the long distance work. For close tuning there is available a variable condenser; also a fixed condenser is shunted across the 'phones.

The transmitting set is made up of the following: ½ K.W. transformer-coil which may be operated with an electrolytic interrupter or by vibrator on direct current, the latter being obtained by a rectifier, which changes A.C. to D.C. A rotary spark gap and a fixed gap are available but he finds that the rotary is the better of the two. A glass plate condenser with twenty plates of glass and nineteen plates of very thin tin-foil is used. He obtains a very sharp wave and with conditions favorable can easily transmit 35 miles. Mr. Yuon holds an operator's license and his call is 1DG.

A recent Club radio display included a replica of Marconi's first set, which sent the first message across the Atlantic; old and modern receivers; transformers, coils, detectors, sending keys and many other parts of apparatus constituting a complete wireless set.

The Radio Club of New Britain was founded two years ago and has been successful ever since. To any person interested in the club's work the club extends an invitation to attend its meetings which are held every Tuesday night. The fee for membership is $0.25 a month and the initiation fee $1.00.

For particulars about the club's work and the requirements for membership address the Secretary, Radio Club of New Britain, 77 Linwood Street, New Britain, Conn.

STANDARD RADIO TERMS DEFINED.

Approved by the Institute of Radio Engineers.

Under this head we will define the most important radio terms each month. Save them and by pasting each in a book (properly indexed) you will have a handy radio dictionary.

104. *Signaling, Duplex:* See Duplex Signaling.
105. *Sharpness of Tuning:* The measure of the rate of diminution of current in transmitters and receivers with detuning of the circuit which is varied.
    If d_2 is the decrement of the free alternating current in the circuit and d_1 the decrement of the exciting E. M. F., then the sharpness of tuning is arbitrarily defined as
    $$\frac{2\pi}{d_1 + d_2}$$
106. *Spark:* An arc of short duration.
107. *Static:* Disturbances caused by atmospheric charging of the antenna.
    Note: When it is definitely known that disturbances are due to atmospheric charging of the antenna, the word "Static" shall be used. In general, disturbances shall be called "Strays."
108. *Strays:* Electro-magnetic disturbances set up by distant discharges.
109. *Telegraphy, Radio:* The art of sending and receiving radiograms.
110. *Telephony, Radio:* The art of sending and receiving radiophones.
111. *Train, Wave:* The waves emitted which correspond to a group of oscillations in the transmitter. See also, Frequency, Group.
112. *Transformer:* In present radio practice the term should be restricted to audio frequency transformers. See Frequency, Audio.
113. *Transmission, Diplex:* See Diplex Transmission.
114. *Tuning:* The process of securing the maximum indication by adjusting the time period of a driven element. See Resonance.
115. *Tuning; Sharpness of:* See Sharpness of Tuning.
116. *Vacuum Tube, Three Electrode:* As examples see Relays, Electron and Gas.
117. *Vacuum Tube, Two Electrode:* As examples see Rectifiers, Electron and Gas.
118. *Waves, Electro-magnetic:* A periodic electromagnetic disturbance progressive thru space.
119. *Wave Length (of an Electro-magnetic Wave):* The distance in meters between two consecutive maxima, of the same sign, of the electric and magnetic forces.
120. *Wave Length, Fundamental:* See Fundamental Wave Length.
121. *Wave Length, Natural:* In a loaded antenna (that is, with series inductance or capacity) the natural wave length corresponds to the lowest free oscillation.
122. *Wave Changer:* See Changer, Wave.
123. *Wave Meter:* A radio frequency measuring instrument calibrated to read wave lengths.
124. *Waves, Sustained:* Waves radiated from a conductor in which an alternating current flows.
125. *Wave Train:* See Train, Wave.

TESTS AND RATING

1001. *Radio frequency generators should be rated* according to their capacity at continuous load. The method of measuring output in operation is given in Sections 1011 and 1012 below. Unless otherwise specified, a continuous load shall correspond to a locked key test.

1002. *Radio transmitting sets should be rated* on the basis of their actual antenna input, not including in antenna input the losses in the antenna switch, and in antenna loading inductances or series capacities. The radio transmitting set starts therefore at the first piece of electrical equipment definitely a part thereof, comprises all further equipment, and includes the antenna switch and antenna loading inductances and series capacities (or any other apparatus placed in the antenna circuit which forms part of the transmitting equipment; e. g., an antenna relay for break system).

1003. The *over-all efficiency* of a radio transmitting set shall be the quotient of the actual power output measured in a standard antenna (either real or artificial) to the power input supplied to the first piece of electrical equipment which is definitely a part of the radio transmitter. Examples of the application of this rule are the following:

1004. (a) *A ship station.* Direct current is supplied from the ship's mains to a motor generator set, which furnishes alternating current to the high tension transformer of the radio set. The ratio of power in the antenna to power supplied to the motor of the motor generator set and to the auxiliary radio equipment (e.g., blower motors, rotary gap motors) is the over-all efficiency.

POCKET DIARY AND YEAR BOOK FOR 1916. Edited by the *Mechanical World.* 429 pages, 85 illustrations, cloth bound, 6 by 4 inches. Price 25 cents. Published by Emmott and Co., Ltd., Manchester, England.

A large fund of valuable information has been crowded into the pages of this pocketbook. There are one hundred and fifty pages of data on steam, oil and gas engines. Such details as indicators, construction of boilers, steam calculations, valve laps and condensing plants are taken up.

Separate chapters are devoted to structural iron work, gear cutting, ball bearings, rope drives and the shrinkage of castings. Thirty pages are devoted to tables commonly used by machinists and designers. There is also a diary for keeping mechanical notes. A commendable volume, indeed, at such a low price, and one that will certainly prove useful to anyone interested in such matters.

ELECTRIC POCKET BOOK FOR 1916, edited by the *Mechanical World,* 240 pages, 130 illustrations, cloth covers, 6 by 4 inches. Price 25 cents. Published by Emmott and Co., Ltd., Manchester, England.

It is impossible for such a small book to contain a complete compendium of electrical information, but this was not the intention of the publishers. The table and the data seem to have been carefully selected to give the most important data on the large number of subjects which it covers.

The first pages are devoted to definitions of electrical units, followed by a discussion on the care and installation of A.C. and D.C. motors and generators with calculations used in their circuits. Lighting and power circuits are rather briefly covered, as well as the controlling apparatus necessary. Data is also given on storage and primary cells, electric lighting, measuring instruments, earth connections, bell circuits, use of electricity in mines, welding and elevators. The final pages are taken up by mathematical tables and a diary for the use of those who wish to keep brief data notes.

The advertising matter on the first and last pages (an abominable European custom in book-making) does not improve the book, but this seems to be characteristic of English publications.

THE ENGINEER IN WAR. By P. S. Bond. Flexible imitation leather, 187 pages ($4\frac{3}{4}$x$7\frac{1}{4}$ inches), illustrated. McGraw-Hill Book Company, New York, N. Y. Price, $1.50.

This book was written by an army officer and the material is reprinted, with revisions and additions, from *The Engineering Record.* The aim of the book has reference to the training of the citizen engineer to meet the military obligations of citizenship. The duties of the military engineer are explained at some length, while separate chapters are devoted to such topics as stream crossings, roads, fortifications, demolitions, map sketching and sanitation. The work of the signal corps, which brings in essentially electrical applications, is not mentioned, but the subjects treated on cover all the more important duties of the military engineer as outlined above. A number of excellent illustrations help to make the text more comprehensive to the lay reader. It is a book worthy of attention by all at this time and especially those skilled in electrical and mechancial matters.

ELECTRIC WIRING DIAGRAMS AND SWITCHBOARDS. By Newton Harrison, with additions by Thomas Poppe. Second edition, revised and enlarged. Flexible imitation leather, 303 pages ($4\frac{1}{2}$x$6\frac{3}{4}$ inches), 130 illustrations. The Norman W. Henley Pub. Co., New York, N. Y. Price, $1.50.

This volume is intended especially for those interested in the designing and constructing of switchboards. Tables are given for the carrying capacity of copper wires of various sizes, current required by carbon lamps (but not for Tungsten lamps, strange to say), etc. The underlying principles of the why and the wherefore of each computation is explained briefly—too briefly it seems for many who will read this book. However, for those engaged in figuring out such problems in their everyday work, this book will prove of service. Considerable space is devoted to alternating current calculations, transformer connections for phase changing, circuits of various types of watt-meters, etc. It would seem preferable to have presented the A.C. line values for inductance and capacitance in tabular form instead of in rather brief formulae.

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

PUSH BUTTON.

(100) Wells Asbury, Clarkesville, Georgia, has submitted a very unique idea for making an electrical push button for ringing bells, etc., which generates its own current. Our advice is asked whether or not this could be patented, and if it would pay to patent it.

(A) This idea is an excellent one, providing the button could be manufactured cheap enough. There should be an immense market for it, providing the button could be sold for $2.00 apiece or less.

Our advice is to get in touch with a patent attorney at once.

ELECTRIC BICYCLE.

(101). Karl Lopsein, Germantown, Cal., has been figuring on making an electric bicycle and would like to have our advice as to its practicability and whether it will work as described. The idea of the construction is to put a generator in a convenient place on a frame and run it by foot power which in turn supplies the current for the motor, this finally to propel the bicycle.

(A) While a device of this kind would undoubtedly work, there certainly is no advantage whatsoever, as quite a good deal of the foot power is lost in the transmission of one form of power to another. We do not think the device practical at all.

AUTOMATIC TRAIN STOP.

(102.) Ina K. Robinson, South Haven, Kans., proposes to place a horizontal lever on each side of the locomotive which would extend a few inches, the inner end of each being connected to switches, such switches to control a circuit so that when the switch was closed the throttle would be closed and the brakes applied. Several other points are mentioned in connection with this idea.

(A) Devices of this sort are not very popular with the railroads, as they do not seem to favor extending levers, although a few railroads have adopted similar schemes. Unless an entirely new device were devised in such a scheme, we doubt if a patent could be obtained.

BICYCLE CARRIER.

(103.) Norman E. Himes, Norwich, Conn., has an idea for a carrier for a bicycle which he thinks could be sold for 25c at a good profit. It is to be made of light sheet iron enameled and fastened under the seat. It is to be specially used to carry books, parcels, etc.

(A) While the device as described seems very satisfactory and while we think that a patent might be obtained on a device of this kind, we do not think that there is a very great market for such an article. There are a good many such devices on the market already.

CHEMICAL APPARATUS.

(104.) Dole A. Miller, Toledo, Ohio, has devised an apparatus designed to separate hydrogen and oxygen, consisting of several brass chambers. Other details are also given and the apparatus is supposed to be used by high schools, universities, etc.

(A) Without seeing sketches or more detailed description of the apparatus it is impossible to say whether a patent could be obtained or not. There are so many such devices on the market to-day that we doubt whether one could be designed original enough on which a patent could be obtained.

ELECTRIC AUTOMOBILE PLANT.

(105.) Claude Spitzer, Grottoes, Va., has sent us a very elaborate drawing and description as well, of an electrical transmission for automobiles. The device consists of a dynamo generator driven by a gas engine, the generator in turn supplying current to two electric motors which drive the car. Our correspondent, who is certain that a patent can be obtained on this device, wants our advice as to the practicability of it and whether an article of this kind would be satisfactory from a manufacturing viewpoint.

(A) Electric transmissions on automobiles are not new but the one of our correspondent shows several distinct improvements, especially as far as the arrangement of the motors is concerned, which drive the wheels. Several novel points are contained in the invention and while we do not think that a patent could be obtained on the invention as a whole, one or more patents might be obtained on several of the different ideas. "Electric" automobiles seem to be coming into favor more and more, and there is a distinct advantage to have a gasoline engine drive a generator which in turn drives the automobile. This is not at once apparent to the layman on account of the loss of the power. In automobiles, however, a small loss of power is not considered much if the smooth working of the car is taken into account and if the far better control of electric driving is considered.

We would advise our correspondent to get in touch with a patent attorney.

NATURAL GAS FOR AUTOMOBILES.

(106.) St. Elmo Brumback, Missouri, informs us that he has been using natural gas

in his stationary gasoline engine, and he wishes to know whether it would not be possible to compress the natural gas into a tank of suitable size in order to drive the automobile.

(A) Anything is possible and there is no question that a scheme of this kind will work to a certain extent. The great question, however, is, how far can an automobile run on natural gas even if it should be compressed into steel cylinders. The weight of such cylinders would be quite high and we doubt if 10 miles could be covered with such an apparatus. However, in certain cities where natural gas costs practically nothing, it might be possible to exploit an idea of this kind. But it would hardly be practicable for cities, where natural gas is unobtainable. As to patenting a device of this kind, we doubt very much if the patents would be worth much to the owner.

STREET CAR INDICATOR.

(107.) W. N. Thompson, New York City, has devised a street car indicator whereby the next street reached will automatically appear on a certain device in the car without the necessity of its being watched by the conductor. He wishes to know whether a device of this kind is satisfactory and whether it can be patented.

(A) There are one or two such devices on the market and some of the European cities have tried them. But, to our knowledge, no great headway has been made. It is comparatively simple to manufacture a device of this kind, and if the car would always run perfectly even, all that would be necessary would be to affect a transmission from the axle of the car to the device and theoretically this should work out perfectly. Unfortunately, this never appears to be the case in practice, for the simple reason that the car wheels going around curves experience more or less slippage. Also, on a wet day the car wheels make a great many more revolutions than they do on a dry day on account of slippage also. Consequently, the indicator would indicate a certain street long before the street in question was actually reached, and if the distance traveled by the car is long enough, the information conveyed to the passengers would be entirely wrong. This is what inventors have not as yet worked out satisfactorily. It is worth while tackling.

AUTOMATIC SELF-STARTER.

(108.) Robert Fisher, Arkansas, has submitted an elaborate sketch and drawing of an automobile self-starter which works on the principle of coiling a large powerful spring which is automatically wound by the engine when it gains speed. The energy of the spring would afterwards start the engine when required to do so.

(A) This is a very doubtful idea and we do not think that a spring could be made which would work satisfactorily for any length of time on a device of this kind. Of course very powerful springs could be constructed to start turning the motor, but we have our doubts as to whether the device would be practicable and whether in the end it would not cost more than the present starting means.

MULTIPLEX TELEGRAPH SYSTEM.

(109.) Chase Hutchinson, Knoxville, Tenn., sends us a sketch and description of a multiplex telegraph system. He wants our advice on same.

(A) Devices of this kind are not practicable. We think the expense is too great to warrant practical use in exploitation and also because harmonic relays are too costly.

WIRELESS AND AEROPLANES AID EUROPEAN "GUN-SPOTTERS."

(Continued from page 469)

a hill is a common occurrence on many of the battle fronts of Europe, and it is one of the standard exercises proscribed for the artillerymen of the United States Army.

As aeroplane radio sets have been greatly improved since the start of the present European war, it is now feasible for aeroplanes to maintain reliable radiocommunication over distances of forty to fifty miles. Some of these wireless sets operate on batteries, but the majority of them are designed to be excited from a small dynamo driven by the aeroplane engine. Aeroplane radio sets of American design are being turned out which do not weigh above fifteen to twenty pounds. Specially designed receiving sets are supplied for aviators, combining a leather helmet with the sensitive telephone receivers in-built to form an integral part of the entire head-gear. The antenna on aeroplanes has to be especially well insulated and many freak arrangements of the aerial conductors are to be seen. A single wire depending downward from an automatic take-up reel is extensively favored. In other cases the antenna is spread over the length and breadth of the machine, and suitably supported so as to be clear of grounding on the metal parts of the aeroplane frame and engine.

LIGHTNING MADE TO ORDER.

(Continued from page 474)

volts and a frequency of one hundred thousand per second! The flame-like discharge measures sixty-five feet across. This experiment was performed for the purpose of showing how the nitrogen of the atmosphere could be made to combine with the oxygen. The large wire cage measured 20 feet in diameter and 30 feet in height. This is not the actual coil which is excited by the primary of the Tesla transformer, but a separate helix which is attuned to a certain frequency of the secondary of the transformer. This is apparent by noting the large circular fence-like wall in the rear, which measures 60 feet in diameter and which is wound full with heavy copper wire.

The primary is carefully imbedded in the ground and connected with the regular oscillating circuit, comprising high tension oil condensers and the inductance incorporated in the primary of the Tesla transformer, also a spark discharger. In all these experiments the primary of the low tension transformer was excited with 300 kilowatts of electrical energy.

A very striking experiment showing the emission of an electrical discharge from a large sphere is shown in Fig. 2. The ball has a surface of twenty square feet which represents a large reservoir of electricity. The inverted circular pan underneath with sharp rim has an opening thru which the electricity can escape before filling the reservoir. The quantity of electricity liberated is so enormous that, although most of it escapes thru the rim of the pan or opening provided, the ball of the reservoir is nevertheless alternately emptied and filled to overflowing, as is evident from the discharge escaping on the top of the ball.

The coil shown in Fig. 3 creates an alternative movement of electricity from the earth into a large reservoir and back, at the rate of one hundred thousand pulsations per second. The adjustments were such that the reservoir fills and bursts at each alternation just at the moment when the electrical pressure reaches the maximum. The discharge escapes with a deafening noise, striking an unconnected coil twenty-two feet away, and creating such a disturbance of electricity in the earth, that heavy

sparks an inch long were drawn from the water main at a distance of three hundred feet from the laboratory.

One very interesting experiment conducted by Dr. Tesla showed how it is possible to tune several coils to different frequencies with respect to the fundamental frequency generated by the main exciting coil. A photograph showing this experiment is reproduced at Fig. 4. The large coil on the right, discharging strongly, is tuned to the fundamental vibration which is fifty thousand cycles per second; the two larger vertical coils to twice that number; the smaller coils, wound with white wire, to four times that number and the remaining small coils to higher harmonics. The vibrations produced by the oscillator were so intense that they affected perceptibly a small coil tuned to the twenty-sixth harmonic above the fundamental.

The scientific world is keeping its eyes peeled for the next epochal movement in the problem of transmitting energy *via wireless.* And the world expects Dr. Nikola Tesla to do this.

UNCLE SAM'S NEW 40-MILE AN HOUR "ELECTRIC" BATTLE-CRUISER.

(Continued from page 479)

spray burners, as compared to the bulky Scotch boilers as installed on the Cunard liner, the *Lusitania.* The *Lusitania* developed 70,000 H.P. maximum from her power plant, with a resultant speed of somewhat over 25 knots per hour. This vessel measured 790 feet in length with a 98 foot beam.

Not only have the technicians of Uncle Sam's Naval Construction Board evolved something startling in the form of a wonderfully fast battle-cruiser, but they will carry something entirely new in heavy ordnance.

The big gun armament of these battle-cruisers will comprise eight 16 inch, 45 caliber rifles of a new type but recently developed by the U.S. Navy. It is said to be the most powerful gun in the world, firing a 2,400 pound shell with an initial velocity of 2,600 feet per second, or with an initial energy of 100,000 foot-tons.

Hence, when the officer in command presses an electric button that discharges a salvo from this mighty fighter of the seas, there will be represented a force of 800,000 foot tons, from the big gun battery alone—not to mention the secondary battery of six-inch and smaller caliber rifles, which will line the gun decks of the 900-foot armored hull. Thus, the primary battery of 16-inch rifles will develop sufficient energy to lift 2,000,000 pounds, 800 feet into the air. These large caliber rifles can be made to fire once every minute and faster when necessary. They will have about 25 degrees maximum elevation and a possible fighting range of approximately 30,000 yards.

It has been declared by naval experts that so remarkable is this new 16-inch gun, that under favorable conditions it would be possible to plant successive salvos on an enemy ship with accuracy, at a range of 25,000 yards.

The most important functions cared for by electricity on the modern battle-cruiser or dreadnought of the class above described are partly shown in the accompanying illustration with each particular part numbered, so that those interested can readily locate the most important general features of this truly wonderful craft. The key numbers start with the anchor hoist on the forward deck, just in front of the forward 16-inch gun turret. We will consider here simply a few of the more interesting and vital features involved in

the control and operation of these new electric battle-cruisers.

As already mentioned, the power plant will depend upon oil fuel instead of coal. A large battery of water tube boilers, as shown in the drawing, will produce a high-pressure steam and this is fed into the turbines, which are directly connected to the electric generators. These, in turn, are electrically connected to the main distribution switch-board in the engine room. This switch-board contains the necessary measuring instruments such as voltmeters and ammeters, also protection apparatus such as circuit-breakers, etc. There are a number of auxiliary switch-boards besides, the principle function of which is to serve as remote control boards for the circuits running between the conning tower or bridge, just back of the forward 16-inch gun turret, and the propelling and steering motors.

The entire equipment, or, at least the propelling and steering functions inherent to it, may be controlled from either the bridge or the armored conning tower just below the bridge, and in event of the superstructure of the vessel being shot away in battle, the boat is still immune because of a third pilot room, located several decks below the conning tower, in a well-protected position as shown in the illustration. Thus, the vast difference between this modern, electrically propelled and steered vessel, and the older, steam-driven types, becomes readily apparent, as in the older fighting ships the officers on the bridge or in the conning tower, had to give the men in the engine room the necessary orders by means of an *engine room telegraph,* as it was called. In these new craft, thanks to the high efficiency and positive action inherent to control by electricity, those in command on the bridge, for instance, can handle the vessel directly by means of suitable switches and tell-tale annunciators located before them.

The electric steering equipment is of interest on these new ships, the rudder being swung either to right or left by means of electric motors controlled from the bridge or conning tower. And the exact position of the rudder at any instant is made manifest by means of a multi-segment switch mounted on the rudder post, which controls a lamp annunciator on the bridge. The swing of the rudder from right to left is divided into a number of small divisions each corresponding to several degrees of the helm arc. Each division is indicated by a certain annunciator lamp, which lights up when the rudder lies in that particular angle.

Suppose one of these fighting monsters to be steaming lazily along at sea, when suddenly a radio message is received (in either one of the two radio operating rooms shown in the illustration). And further consider that the radio message is important, stating, for example, that enemy war vessels are but a short distance away. Then, the all-important question to the layman is—Just what does happen in order to get the fighting ship into battle trim instantly?

The officers and lookouts on the bridge and at the mast-heads, begin to scan the sea with their telescopes for the first sight of the enemy. As soon as the radio order has been received by the officer in command, he transmits the necessary instructions to his subordinate officers. One of these men, by simply pushing an electric button on the bridge of the ship, causes general alarm bells to sound throughout the entire vessel. The sailors, gunners, engineers and others may be lounging about the ship, but the instant these electric gongs

begin to sound, they proceed immediately to their assigned battle quarters. The gunners are at their proper places in a few seconds. The decks are cleared of all their railings and loose fittings, such as life rafts or boats, including the life boats and launches on the super-structure, in proximity to the smoke stacks. If the decks are covered with wood, this is removed and thrown overboard, as it was found, in the Spanish-American War, that more damage ensued from the flying splinters of wood hit by shells, than from any other cause. Some of the splinters even entered the gun turrets through the gun loop holes. Also, there is constant danger of a conflagration when wood is present, so the imperative order now-a-days is to immediately dispose of any wooden object by casting it overboard. The fighting monster is thus entirely sheathed in steel, and a clear way is made in all directions for the cannon-fire. The general alarm gongs keep ringing periodically every few seconds, and in but a few minutes' time after the enemy has been reported, the fighting craft is ready for action.

If desired, the officers give the order to those in the boiler room to regulate the machinery, drafts, etc., so as to cause heavy black smoke to roll from the stacks. This move is often necessary when other ships are to be screened from the enemy temporarily, or even to help conceal the vessel herself. For battle trim, the radio operators move their headquarters down to the *battle* radio room, located on one of the lower, protected decks, as shown in the illustration. This room is specially built with sound-proof walls and a door that cuts off all sound. Fresh air is pumped into the chamber by an electric blower, so that very little sound of the cannon discharges can be heard.

In the preparations for battle the electricians have been among the busiest men on board. One of their principal duties is to lower over the side of the hull the two auxiliary aerials; one on the port side and one on the star-board side. Thus, there are three radio antennæ in service, and the enemy has to shoot down the port and star-board aerials and also that between the mast-heads, before radio communication is cut off entirely. There are also provided sensitive, electric microphones for the detection of approaching submarines or other vessels, these instruments being placed, of course, below the water line. Submerged torpedo tubes are also ready for service, both fore and aft. The gunners, as well as those in the torpedo rooms, wear telephone receivers on their heads, which are connected up with the fire control officer located on the bridge or in the conning tower.

The push of a button on the bridge and the ammunition room door whistles sound; a short time after the doors close, a tell-tale lamp before the officer acquainting him with the fact.

As soon as the enemy comes within range the fact is communicated over the telephone system connecting the range finder officers, located atop the shell-proof, basket masts, to the gunners below. As soon as he has found the range, which takes but a few seconds, the man at the range finder telephones the corresponding distance, as well as the wind velocity and other necessary information to the gunners throughout the ship.

Everything goes like clock work, and although it takes several minutes to read just these few lines, all of the operations here cited and a hundred others take

place with absolute precision in a few seconds.

If the enemy ship presents a suitable target for a broad-side or *salvo*, the officer on the bridge so informs the gunners in all the big-gun turrets. These can be swung either to port or starboard for firing a broad-side. The gunners at the 6-inch and smaller rifles on the gun decks amidship are notified when a full broad-side is to be fired.

Salvo firing can be controlled very accurately, when necessary, by telephone, and the guns are fired (electrically) by the individual gunners, on what is termed in naval verbiage—the *salvo buzzer*.

It is usual for medium size guns, such as the 6-inch rifles, to be required to fire within 5 seconds after the salvo buzzer sounds; 5 seconds being allowed for reloading. This makes an average of 6 shots per minute. The heavier, 16-inch rifles, of course, cannot fire so fast and a special circuit controls the salvo buzzers in all the turrets.

Thus, the entire fighting ship is soon put under the dominant control of the officers in command on the forward bridge or in the conning tower. They may run the vessel ahead or astern. When they deem it the psychological moment for a broad-side, they have but to press a button, and before they can count 10, there will be hurled forth from the brazen throats of the mighty guns an avalanche of shot and shell representing over 2,000,000 foot-tons of energy—sufficient to blast any ordinary war vessel clear out of the water.

In the gun turrets, electricity is the all-important factor, as it proceeds to go about its duties in a noiseless and uncomplaining manner. The gunner behind the breech of the 16 inch-20 mile gun has but to push a button when this mighty steel cannon rapidly rises or falls, just as he desires. Pushing another button causes the turret to revolve and stop at any desired angle or fraction thereof. Electric motors revolve the turret by means of rack and pinion. The telephone receiver gives him telephonically the range and angle functions as obtained with the range-finding instruments located atop the observation masts, as well as from range-finders on other parts of the vessel. The electric firing buzzer gives him the signal for discharging the gun. Loud-speaking telephones are used for all such communications in many instances, particularly for giving orders between the turret chamber and the ammunition rooms, several decks below.

The whirr and buzz of electric motors is heard as they hustle the 16-inch shells turret-ward. And so, as we go over the ship from stem to stern, we find electricity performing a thousand and one wonders here —there—everywhere.

In moments of lighter vein when the Jackies are taking life easy, you may see how electricity is used for all the domestic requirements on board ship, whether it is for washing dishes or peeling potatoes in the kitchen, or turning a lathe in the machine shop. Again, perhaps we hear the whirr of a motor as it busily revolves one of the rotary clothes washers in the laundry. And so we come to know that it is electricity that ventilates, drives, illuminates and steers this wonderful creation of the human brain—the greatest naval advance in a decade. Once we were content to read about 40 mile per hour motor-boats, but here we are face to face with a 900-foot, honest-to-goodness, hell-raising sea fighter that can dash down on the enemy with express train speed and lash the devil out of him with broadsides of 16", armor-piercing shells. Even the Kaiser will have to rub his eyes and blink at Uncle Sam's latest "peace-inspiring" persuaders.

TESLA VS. MARCONI COMPANY.

The answer of the Marconi Wireless Telegraph Company to the suit of the Nikola Tesla Company for an alleged infringement of its patents, was filed recently in the Federal District Court. The Marconi Company denied that Mr. Tesla was at any time the original or first inventor of the alleged new and useful method of signaling set forth in the complaint. The answer also denied that the patents issued on March 17 and April 14, 1903, were duly or lawfully granted to Mr. Tesla, because he had not complied in all respects with the conditions and requirements of the patent laws. The defendant company asks that the complaint be dismissed.

JAMES CLERK MAXWELL.

(*Continued from page 471*)

had taught in London only eight years when the state of his health became such as to force his retirement to his country estate in Scotland. Somewhat improved by his stay there, he became professor of experimental physics at Cambridge, in 1871. Only eight years later he died at the age of forty-eight.

At the International Electrical Congress, held in Paris in 1900, the memory of Maxwell was honored in giving his name to the unit of flux in a magnetic circuit—this unit corresponding to the ampere in electrical circuits.

WHEN AMATEUR WIRELESS WAS YOUNG.

(*Continued from page 488*)

scene of ye scribe's activities shifted to the city of brotherly love, Philadelphia. Here, after his miscellaneous "junk" and other paraphernalia had been ensconced in one of the famous (or is it infamous?) old boarding houses, that line Spruce Street, many wild dreams presented themselves to his imagination. One of the most pertinent of these was, that no longer would the old shellacked, two by nothing receiving cabinet suffice. Nothing to it—it must go. And it did, giving way to a most wonderful and fearful receiving "set." To begin with, this was to be a real outfit; one of those affairs that caused even your friends to throw up their hands and exclaim in wonder "What's this for?" and "What's that for?" and "Why do you have to use this?" and so on, *ad infinitum,* for about half an hour. By this time, after having read a number of books on the subject, there were, of course, always some *new* ideas to be added or incorporated in the outfit. These ideas multiplied bewilderingly and threatened to even scare the writer in their enormity. Before long there were so many wires, switches, chokes, jiggers, shunts and condensers hooked up to the 5000 ohm, polarized relay and coherer, that it is really doubtful when a regular wireless wave of respectable power did manage to enter the aerial and ground terminal post on the handsome oak cabinet, whether it could find its way through the maze of apparatus.

This "set" was finally, however, tuned up in good shape and gave excellent satisfaction. The two-inch spark coil was usefully employed in giving demonstrations with it and two pieces of brass tubing about three feet long, served as *aerial* and *ground,* as most of the tests were made only through the wall between two rooms, or between the third floor and the first floor of the dwelling.

An amusing, albeit not very pleasant experience, comes to mind when on one occasion there was a lecture to be given with this set at one of the local high-schools. At the last moment the glass coherer tube cracked and all the precious gold, silver and nickel filings flew pell-mell over the edge of the table and on the carpet. This was a hopeless case indeed, for the moment; but, recollecting that not many blocks away there was a scientific instrument company who manufactured demonstration sets of radio-telegraphic apparatus, a call was made on them at once. To be sure, they would be only too glad to sell a *filling* for a coherer. After we had sworn by all the Holy Saints that our set was really one of their manufacture, and after waiting for about an hour for the arrival of the precious filings of unknown origin, they came to hand, and the bill nearly knocked off our hats. For they only wanted $2.00 for each *filling* and there were two fillings in the envelope, which the clerk politely stated to be the minimum order for them which they would handle.

One more experience will be related and

one which will be quite familiar to every electrical experimenter who has lived away from home, cooped up in one of those private *boudoirs de luxe* for which the honorable boarding house mistress has the courage to demand anywhere from 3 to 5 cold simoleons per week. In one of these almost civilized habitats the writer had the audacity to undertake the construction of a large spark coil. Every electrician knows what that means. For, if it is to be a regular coil, the secondary must absolutely be made in sections and of course the thinner the better, as we all know. Everything happened, and then some, in the ensuing month and a half during which the construction of the coil parts and particularly the secondary proceeded with all possible haste. Patience is a virtue, to be sure, but it has a doubtful and variable place in the vocabulary of the electrical experimenter. He no sooner starts to build an apparatus when he begins to anxiously long for the final moment when everything will be ready to throw in the switch and watch the results. The spark coil, which was to be an eight-inch one, got along famously until it came to winding the secondary pies, each of which consisted of several hundred turns of very fine silk covered magnet wire run through a molten paraffine wax bath, as they were wound on to the former.

Luckily, it was during the winter months that this exciting *indoor sport* took place, and though the author worked diligently at it, even to the extent of spending every evening and holiday on the job, it required well over a month until the 115th pie (God bless it) was finished. If you do not know what trouble is, then you simply have to try carrying out such an operation as this in someone else's home, yes, even in a boarding house. Paraffine wax is a very innocent looking commodity when it is solidified. But allow a fair-sized quantity of this important substance to be molten over a stove in a closed room and watch the results. Not onl, an uncomfortable amount of smoke is produced, but there is a rancid odor emitted with an unholy decrement, which has a persistent affinity for all doors, cracks and other openings. The reader may judge for himself of the howls and kicks made by the other occupants of the house while these *scientific* operations proceeded with all due haste. This haste was not altogether and totally due to the natural desire to see the final results of the spark coil, nor to the black looks and ungrateful remarks of those who passed the *laboratory* door, but distinctly and very pertinently to the fact that nothing but a gas light was supposed to be used in this *boudoir*. Finances had to be stretched in those days to the utmost limit in order to pay for the silk covered wire and other gadgets which were to adorn this masterpiece.

A gas stove bill could not be countenanced for one moment; hence there was always intense excitement whenever someone knocked at the door, for at that psychological moment everything, including and not forgetting the Bunsen burner which heated the wax, had to be heaved post haste into the nearest bureau drawer or into the trunk, and the key turned. And, what was worse, we had to conjure up a face which personified innocence itself, particularly when the caller who had so politely knocked at the door happened to be Her Royal Highness—the Landlady, sniffing suspiciously over the land!

Yes, those were the palmy days—but never again. The wife wouldn't stand for it.

THE MARVELS OF MODERN PHYSICS.

(*Continued from page 485*)

ted, and on the strength of this a wonderful station was built on Long Island. Every reader of scientific periodicals is familiar with its picture and history. At present it is deserted, but Tesla is still working upon the subject. The problem, however, is as yet unsolved. We will not say it is impossible of solution, for do we not have real wireless transmission of power as an everyday occurrence in the ordinary transformer? Though there is no metallic connection between the primary and secondary coils, yet there is an immense transfer of power at only a slight loss. Notice how near the ideal conditions are, however. The distance is negligibly small, and even the

medium itself is improved by the presence of a soft iron core. It is too common a fact for us to consider it wonderful, and yet the result is the same as that which has puzzled many scientific minds to reproduce or duplicate through any great distance.

As wireless telegraphy and telephony supplement, rather than take the place of the ordinary systems and as the transmission of power is the back-bone of commerce and industry, it seems the wires are here to stay for a long time to come. However, we must not disrespect the possibility of just as revolutionary discoveries in the future as have occurred in the past, hard as they are for us to even conceive of now. Why, even wireless telegraphy would not have approached the success it has, if the energy radiated directly by the Hertzian oscillator had been depended upon. In the first place the decrease of energy, as shown by the above law, would have been so great as to have been discouraging; and secondly, the fact that radiation travels in straight lines would have made long distance communication impossible, owing to the curvature of the earth. Both of these theories were advanced early in the development of the subject, and when approached near at hand were neither of them found as forbidding as they had seemed. It was shortly found that when the sending station was suitably grounded, that the waves actually follow the surface of the earth, and the invention of sensitive detectors made the transmission of a large amount of energy unnecessary for signaling. Many such facts about wireless telegraphy are a mystery to the average person, and although the mathematics of radiation were actually worked out over sixty years ago by James Clerk Maxwell and his co-workers, many of the exact physical actions which take place are but little understood even by the brilliant scientists of the present day. Much more is known, however, than formerly.

The wireless wave follows the earth as a huge conductor, because when the oscillations occur in the aerial, shown in Fig. 3, the lines of force moving up and down the aerial with the oscillating charge, throw off loops as shown, which are waves traveling partly *in* and partly *above* the earth. These travel off exactly like ripples on a pond, and also follow the curvature of the earth. They are much stronger than if radiated in all directions. It is evident they are not as *wireless* as they might seem, for the earth acts as a huge conductor. In early experiments between Lynn, Mass., and Schenectady, N.Y., communication was found impossible, due to the dry rock mountains intervening which acted as effective, *non-conducting* carriers. Not long afterward communication was established between Clifden, Ireland, and Buenos Aires, S.A., a distance of six thousand miles, the intervening water being a good *conducting* medium.

Wireless telegraphy and telephony are now of immeasurable commercial value, to say nothing of their importance from a purely scientific standpoint. It may even be said that we have been approaching as a limit the *wire* transmission of power for some years. In 1890 a power line was established, thirteen miles long, at Portland, Oregon, which transmitted current at 4,000 volts. In 1903, in Mexico, a line was built 104 miles long, to operate at 60,000 volts, while in 1913 the Pacific Light & Power Company of Los Angeles, Cal., began operating a line 240 miles long at 150,000 volts. This latter means a comparatively small current and a small conductor acting more and more as a guide rather than a vehicle for the power. Has a limit been reached; or will this record distance and voltage soon be eclipsed? It is a problem the engineers and scientists will try to solve in the near future.

The wireless era does not mean an era where wires are taken down and thrown on the scrap heap. We must not look for scientific miracles for nature follows natural laws. It means an age where an extra gift has been given to man, enabling him to extend his influence beyond the sphere of base matter; to annihilate distance and gain control over the finer forces of nature.

[*This is the tenth paper of a series prepared exclusively for "The Electrical Experimenter" by Mr. Rusk.—Ed.*]

BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page 513*)

Water on Mars is very scarce. None must ever be lost by seepage into subterranean soils, to vanish forever as far as the Martians are concerned. This has already happened on the moon, where no water is to be found along its surface except in the interior, and here most of it is ice.

By guiding the waters in waterproof canals, practically no loss is occasioned by seepage. Even where the waters are finally conducted to fertile grounds, here to grow grain, vegetables, trees, etc., they are not allowed to seep into the sub-soil. The method of doing this is as simple as it is efficient. By means of the purple disintegrating rays, the site to be used later for agricultural purposes is treated exactly as is the canal proper. This site, connected to the parent canal by narrow feeders, is as deep as the former and is, of course, waterproof. It is then filled in with fertile soil and is now ready to grow plants, trees, vegetables, etc. Thus no water is ever lost.

I must also add that when the emanation ray has transformed the bed of the new canal into its lava-like condition, this crust becomes conductive to the Martian *Ion* currents; the rest is an insulator.

I have explained to you before, that the waters in the Martian Canals are made weightless by nullifying the gravitational effect of the planet, by conducting an Ion current through the bed of the canal.

The waters, now being weightless, are easily pushed along by the rays coming from the stationary towers which line the canal, as reported some months ago.*

While this explains much of the mystery, you probably are still puzzled, as are all our scientists, why the Martian Canals are so tremendously wide. You know that several of the larger canals measuring 3,000 miles in length are from ten to twenty miles wide. Why such an extraordinary width? Would it not be better to make the canals very deep and but a few hundred feet wide, thereby saving an immense area of land, which is none too plentiful on Mars?

Again the answer is simplicity itself, although none of your scientists ever guessed it. Our host explained it to us in a few seconds. The answer to the riddle is: Evaporation.

For on Mars there are no oceans, not even lakes if you except the small circular ponds at the junction of several canals, or wherever canals cross each other.

Now then, if the canals were not so wide, the water would not evaporate fast enough into the air, here to form water vapor, the latter to be deposited finally at the two poles in form of snow and ice. The great width is absolutely necessary in order to obtain the required evaporating surface.

So nicely has all this been adjusted that by the time the canals reach their furthest North or South extensions, they carry practically no water in their shallow beds. It has been used up mainly for irrigation purposes and the balance has evaporated,

*An explanation how the Martians move the waters in their canals is found in a previous installment, published in the December, 1915, issue.

to be re-used next season and so on. Thus have these intelligent people wrestled with a tremendously vital problem and by their superior intelligence their water supply seems secure for thousands of years to come.

But my chronometer tells me that the recording wire of the Radiotomatic Plant on the moon is almost full to capacity. I must break off till tomorrow. Good Bye, my boy. Professor Flitternix joins me in my salute. *Au revoir* and once more good night. . .

(*To be continued*)

Electricity is now extensively used to harvest ice from rivers and ponds. The electric motors drive the ice harvesting machinery, trim the cakes and elevate them to the ice houses.

HOW THE WIRELESS AMATEUR FARES IN NEW ZEALAND: A RECENT COURT CASE.

Through the courtesy of one of our readers of Wellington, New Zealand, we are able to present some side-lights on the Amateur Radio operator's existence in that country, or rather his non-existence. The following brilliant excerpts from the court testimony of a recent "violation" of the Radio Act in force in New Zealand, make highly humorous reading. The maximum penalty for violating the law by erecting an experimental or *any* form of radio station is $2,500.00, sufficient to deter most anyone from experimenting with either wireless or the law. We read in "The Poverty Bay Herald" for July 4, 1916:

The hearing of the case in which Ercil Mervyn Goffe (aged sixteen years) was charged with erecting a wireless plant without the consent of the Government, was proceeded with at the Police Court on July third. Arising out of the same matter William Edward Goffe was charged that between January and June, 1916, he did aid his son in the committing of the above offense

Mr. J. R. Kirk appeared for the defendants and entered a plea of guilty.

His Worship said he should require some evidence as to what the plant was capable of doing.

Detective McLeod said the case against the boy was laid under section 164 of the Post and Telegraph Act. The facts were that the lad, who was living with his parents in upper Ormond Road, according to his own statement, started, about two years ago, to study wireless telegraphy. He erected an aerial as a preliminary, and about six months ago he completed the plant with the necessary instruments, and he commenced sending messages by dots and dashes, but could not send for more than about a mile. He also erected a small outfit in the same yard about a chain away and got a small boy to work the instrument, in order to ascertain if his machine would receive properly. No doubt his father knew the plant was there. There was a two and a half horse power benzine engine in the shed and the boy stated that he used the coils from this engine to get the motive power for the wireless, Mr. Carmine, the assistant supervisor of the local telegraph department, would explain the strength of the instrument if it was properly fitted up. When the plant was taken possession of it was dismantled.

His Worship: When was it dismantled?—Detective McLeod: On June seventeenth, and the information was laid on the twenty-third.

Mr. Kirk said he could have brought evidence to show the foolishness of this plant as a wireless plant for transmitting or receiving, but he did not deem it necessary to do so. Now it was proposed to ask Mr. Carmine, who had not seen the machine working but only after it was dismantled, to speak as to its capabilities. He had advised Mr. Goffe and the boy to plead not guilty, when they would probably have escaped punishment. However, Mr. Goffe desired to plead guilty to a technical breach. Mr. Kirk said he had an electrical expert who saw the plant working and who would say it was only a toy one.

His Worship said he would give Mr. Kirk an opportunity of calling evidence.

Lewis James Carmine, assistant superintendent of the Gisborne Telegraph Department, said that in company with Detective McLeod, on June twenty-third last, he visited Mr. Goffe's residence and inspected a small engine in the shed there.

Witness was questioned as to the capacity of the engine, but said he had not seen it working.

Mr. Kirk objected, and also objected to the witness assuming the capacity.

Witness said the engine was sufficiently powerful to charge the accumulators used in connection with the wireless plant. He saw the room where the outfit had been and inspected the instruments.

Detective McLeod: Assuming they were properly fitted up what would you say their capacity would be?—They would be capable of transmitting wireless signals.

His Worship: For what distance?—Well, I should say they would reach any boat in the bay.

Detective McLeod: And about receiving?

Witness: With the machine properly tuned and with the crystals it would be capable of picking up messages from the Auckland and Wellington stations.

Detective McLeod: The whole of the necessary instruments are here for transmitting or receiving?—Yes, with the exception of the crystals.

(It finally developed that the Amateur never had tried out the instruments; the detector crystal having to be obtained from England.)

His Worship: The engine is not necessary for receiving, is it?—No.

So that the engine had no significance at all as far as receiving is concerned?—None whatever.

This was a low resistance telegraph, I suppose?—I am not prepared to say; I did not measure it.

Would you say it was a high resistance machine?—I would not like to say until I tried it.

Assuming it was a low resistance it would not be capable of receiving long distance signals?—No.

(His Worship evidently is NOT an electrician!!—Ed.)

His Worship: What distance do you mean?—Such as from Awanui or Auckland.

Mr. Kirk: You never saw the engine charge any accumulators?—No.

And you saw the house was fitted with electric light?—Yes.

And the engine was used for providing electricity for the house?—Yes.

Questioned as to a buzzer, witness said such an instrument was not necessary in connection with wireless telegraphy. It was used only for teaching the boys wireless signals. There was no buzzer on the plant in question.

William John Sinclair, electrical engineer, manager for Turnbull and Jones, said he had inspected the plant in question. While a good deal of ingenuity might have been used in the manufacture of the plant, witness did not think it would work at all.

His Worship: But the boy says it did, a little at any rate.

Witness: He may have thought it did, but I don't think so. Witness explained the nature of the instruments required for wireless. To send a message one hundred yards with this plant, he said, it would require an aerial four hundred feet high. The aerial in question was twenty feet high. (You don't say so?!!!—Ed.)

The Judge, good old soul, in his recapitulation, highly commended such enterprising genius in the youth of the land, but to uphold the dignity of the law fined the "lad" ten dollars and costs, and father fifty dollars and costs. And the innocent radio set that was to be, never even whimpered one single dot ten feet. Must be something like that which Senator Sorgum calls "Justice, my boy, Justice!"

And this farce comes from enlightened New Zealand!

SEARCHLIGHT ON HOTEL AN EXCELLENT ADVERTISEMENT.

For purposes of advertising and attracting the notice of automobile travelers approaching the city, the management of Hotel Bancroft, Worcester, Mass., has had mounted on the hotel roof, about 125 feet above the street level, a 24-inch searchlight of 60 amps. capacity, operated on 110 volts.

MEXICAN WIRELESS PLANT IS ENLARGED.

An addition to the wireless plant at Chapultepec, in Mexico City, giving that plant a radius of 300 kilometers, or 1,850 miles, and enabling communication between all the wireless plants of Mexico, has been completed and placed in service, according to a message received by Mexican Consul General T. R. Beltran.

HOUSEHOLD USES OF ELECTRICITY.

Furnish illumination for the house.
Heat water for shaving, or the bath.
Percolate the breakfast coffee.
Toast bread.
Fry eggs or anything that will fry.
Poach eggs, cook the cereal, or heat milk.
Operate the washing machine and clothes wringer.
Iron the clothes.
Run the vacuum cleaner.
Operate the sewing machine.
Cool rooms with an electric fan.
Knead the dough and bake the bread.
Grind, mix, churn, whip cream, make ice cream, polish silver, etc.
Heat a fireless cooker.
Make the tea in a samovar.
Cook food in a chafing dish.
Ignite cigars.
Keep hot the heating pad (used in place of hot water bottle).
Warm the milk for baby day or night.
Pop corn.
Protect houses from burglars.
Amuse the children by running electric toys.
Give electric baths in bath cabinets.
Carry the family in the electric automobile.
Purify the drinking water.
Polish the floors (electric floor polisher).
Dry the washing (electric drier).
Sterilize water or utensils.
Make ice—furnish refrigeration.
Play the piano.
Mix family beverages.
Lift or lower dumb waiters.
Energize doorbells and annunciators.
Curl a woman's hair.
Dry a woman's hair.
AND run your wireless.

WITH THE "AD-MAN"

Along about this time people commence to count up their loose change, and sharpen their pencils to make up their Christmas gift list and in general think of the approaching holidays.

And right here is where I'm going to ask you when making up your list that you consider how many of your gifts can be purchased from advertisers in THE ELECTRICAL EXPERIMENTER.

Wireless Apparatus of all kinds of course, watches, books, sporting goods, electrical apparatus, toys, hearing devices and many, many other things.

But there's one gift I'll bet you never thought of for a good friend or brother, one he will always bless you for. It's a correspondence or resident course in some subject he's anxious to learn. Yes, the course may cost more than you can afford, but at least you can make the first payment for him. Chances are you start him off like that and you will in later years have the pleasure of knowing that you were responsible for the rise in the world of one person.

Is there any greater satisfaction in giving than that?

By the way, if there is any information you want on any of the courses that are advertised in THE ELECTRICAL EXPERIMENTER or those that are not, just ask me and I'll be glad to offer all the information I have available.

Try me and see.

MILTON HYMES.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The *Very* people, the *Only* people, who could possibly have a use for your things read this journal. More than 70,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers' advertising accepted in Opportunity Exchange Columns only.

The rates are: *Three cents per word* (name and address to be counted), minimum space 3 lines. Count about 7 words to the line. *Remittance must accompany all orders.* No advertisement for less than 50c. accepted.

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the December issue should reach us not later than October 25th.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

Subscribers experiencing trouble in dealing with any advertiser should notify the publisher very promptly.

OVER 70,000 PEOPLE READ THIS JOURNAL

SALE OR EXCHANGE—Camera and outfit. Cost $40.00. Send for particulars and list of Radio apparatus. Want sending transformer or what have you? Richard Anderson, North Wildwood, N.J.

BARGAIN—Three 110-volt electric stoves, 65c. each. One electric iron, $1.25. One $2.00 camera, 75c. All goods guaranteed. Prepaid. Richard Gaillard, Pendleton St., Columbia, S.C.

WILL TRADE new Tel-Radion for 43-plate variable, 1,200 meter loose coupler and ¼-inch spark coil for navy type loose coupler. Want ½ K.W. Coil, Audion, Holtzer Cabot phones, variables and other wireless goods. R. A. Ruble, Centralia, Wash.

THREE Audiotron Bulbs, never used, $5.00 each. Postpaid, Electro-selective Coupler, $5.00. Trade for Coupler, Polar relay or Meters. R. G. Anderson, 7211 Indiana Ave., Cleveland, Ohio.

FOR SALE—New Blitzen Variable Condenser, $2.50. Blitzen fixed condenser, 75c. Crystaloi Detector Type AA, $2.50; with Buzzer and Testing Coil, $3.25. Murdock Tuning Coil, $1.50. 1¼-inch Bull Dog Spark Coil, $3.00. Spark Gap, 50c. Everything new, no trade. Richard Taylor, 141 Lake St., Winsted, Conn.

WANTED—Typewriter. Have 24 things in exchange. Send for list. A. Hofman, 382 Cornelia St., Brooklyn, N.Y.

WANTED—AN independent interrupter to be used on a 14-inch Spark Coil. Will buy for cash or trade. R. W. Gates, 826 First Place, Plainfield, N.J.

FOR SALE—Small sending and receiving set. No phones. Cheap. Write for particulars. Elmer Raguse, Tottenville, Staten Island, N.Y.

FOR SALE OR TRADE—Vest Pocket Kodak with leather case, $4.50. Remington Single Shot Rifle, $2.50. Flashlight, 2 extra Batteries, 85c. Premo Camera No. 0, $1.00. Want receiving apparatus. George Coxe, Olean, N.Y.

SPECIAL BARGAINS—Large 115 volt D.C. Fan Motor for $8.00; Sensitive relay, $2.50; new .25 calibre rifle for $4.00; Cover of $5.00 foot-ball for $1.75; Electric whistle, 50c.; Telegraph sounder on marble, $1.00; Telephone receivers and transmitters each 75c.; Magnetos, $2.00 each; 2,000 ohm ringer for $1.00; non-breakable potentiometer, 75c. All in A1 condition. Write for particulars. Clarence Kositzky, 911 South Ninth St., Lincoln, Neb.

FOR SALE—Knapp dynamo-motor, $3.00; tuning coil, $1.25; telephone magneto, $2.00. Trade for good double headset or variables. Raymond Gerich, Rich Hill, Mo.

FOR SALE—9 volt 15 amp. generator, $10.00; ¾-inch spark coil, $2.50. Paul Watson, 214 West Barnard, West Chester, Pa.

FOR SALE OR TRADE—Never been used, $7.25 receiving transformer, 3,000 meter, $6.00; $3.50 Turney variable condenser, 35 plate, $3.00; 70c. fixed condenser, 50c. I want Corona typewriter, Audion detector, Audiotron bulb, aerial material or what have you? George Dimon, 367 Genesee St., Utica, N.Y.

TO SWAP—Old gun valuable as relic, shot gun and rifle, also books for wireless apparatus. Write. Robert Holverson, Kasota, Minn.

MAGAZINE WANTED—Will pay cash for any back numbers or bound volumes of Aero, Aeronautics, Aircraft, Flying, Electrical Experimenter and Wireless Age. State price. L. Koerner, 312 W. St. Vrain St., Colorado Springs, Colo.

FOR SALE—Rotary spark gap, never used, operates on 6 volts. F. C. Cave, Winfield, Kan.

WHAT am I offered for a 3 H.P. Reading Standard, single cylinder, motorcycle engine? Will take wireless instruments, cash or both. Send stamp. R. B. Wailes, 3118 14th St. N.W., Washington, D.C.

FOUR SALES—¼-inch spark coils, perfect condition, giving large spark, 65c. each. Adrian Kishpaugh, Newton, N.J.

FOR SALE or EXCHANGE—2,000 Stamp Collection of rare varieties in good condition; want wireless goods. Albert Hjorth, Port Jervis, N.Y.

SALE OR EXCHANGE—My new 1/6 K.W. Wireless Transformer, New Coherer, 1 K.W. Aerial Switch. Will give 1/6 K.W. for audion bulb. All letters answered. Jeter Pinkston, Valdosta, Ga.

MOTORCYCLE WANTED—Will give $75.00 Receiving Set, $25.00 worth of other electrical apparatus and money. Write for proposition. Van Pattillo, Hartselle, Ala.

LOOK!—25 Steven's rifle and jointed cleaning rod, good as new, $5.50. Also Shaw's smoker used twice, $2.50. Express prepaid. Ingman Ostrem, Perley, Minn.

23 GLASS PLATE sending condenser, $2.00; helix, $1.00, new and never used; fine 75-foot aerial, 30c.; brand new pony receiver, 25c.; complete Hustler Motor, 25c. Rolston Bear, Hemet, Cal.

WANTED—A good headset in exchange for a Victor Phonograph, also camera and outfit, acetylene generator, two tennis racquets, ice and roller skates, and postcard projector. Want wireless apparatus or cash. Write. Roger Hackney, Wellington, Kan.

WILL SELL OR EXCHANGE for high-grade, postcard size, folding camera; one $8.00 2.-inch coil, one $3.00 Murdock 7-plate Variable Condenser. Terms strictly C.O.D. express, $7.00, no installment plan paying. Robert Haag, Chadwick, Ill.

FOR SALE—Will sell my brand new Electro Loose Coupler and Loading Coil for $7.00. Both are new this summer and in A1 condition. Write. Stanley Batchelder, 82 Willard Ave., Portsmouth, N.H.

WILL EXCHANGE $11.00 Omnigraph for Brandes Transatlantic or other 3,000 ohm phones. Must know make beforehand. J. Chaffee, Woodmont, Conn.

$275.00 SLABY-ARCO open core 3 K.W. Transformer, $45.00; 1 K.W. Transformer, $5.00; 10-inch Rotary Gap Wheel for sets up to 3 K.W., $5.00, never been used; Panel and Coils wound and tapped for cabinet set, $10.00. Will make good trade for De Forest Ultraudion or tubular bulbs. Wm. Trumbull, 365 McGraw Street, Seattle, Wash.

FOR SALE OR TRADE—$35.00 Shell Lake Canoe in A1 condition, used three months, for Thordarson or Packard 1 K.W. Transformer or anything you have. All letters answered. Frank Gerster, Havana, Ill.

BUGS!—Big Bargain if you buy my complete sending and receiving Outfit, aerial included, cost $30.00, sell for $20.00. Write for particulars. Fay Williams, Huron, Ind.

SACRIFICE—First $20.00 gets two audions and board; two variable condensers; one fixed condenser; one tuning coil; one potentiometer, also one combination galena silicon carborundum etc. detector. All guaranteed in excellent condition. Write for particulars. R. W. Hoffman, 4011 Greer Ave., St. Louis, Mo.

$15.00 LOOSE COUPLER, $5.00; $7.00 Clapp-Eastham Ferron Detector, $2.50; Omnigraph, 75c.; D.P.D.T. Switch, 75c.; Buzzer; Push Binding Posts; Mineral; etc. FIRST Money order for $10.00 gets everything. Robert Boehner, Brookline, Mass.

FOR SALE—$12.00 1 K.W. rotary, cost $17.50; $7.00 ½ K.W. antenna switch, cost $3.00. Write for particulars. J. S. McDonnell, Jr., 3304 Eighth Ave., Little Rock, Ark.

WANT racing bicycle attachment motorcycle engine. Have athletic and wireless goods. Laurenz, 405 Fulton, Canton, Ohio.

SALE OR EXCHANGE—Two complete sending and receiving outfits. All kinds of Electrical Apparatus sacrificed. Want audion or bulb; switches; storages, etc. Write; all with stamp answered. Frederick McMullen, Fairchance, Pa.

SALE OR EXCHANGE—Camera, Kodaks, Minute Machine; Phonograph, Musical Instruments. Write. S. Copeland, Ahoskie, N.C.

OSCILLATORY SET—3 inductances, 4 variables (Murdock's, Blitzen, Amco), Radio (Pottstown) coupler, $20.00. 3,500 mile range. J. McKenna, Shonnard Terrace, Yonkers, N.Y.

EXCHANGE—E-flat Clarinet and Navy loose coupler for 1 K.W. transformer, either open or closed core. Both articles perfect condition. A. Ericson, 19 Bartlett St., Beverly, Mass.

SALE OR EXCHANGE—Edison Standard Phonograph; 50 4-minute, 15 2-minute records. Good condition. Cost $60. Would like audion detector or amplifier. George Perkins, 365 Union St., Jersey City, N.J.

FOR SALE—Two-inch spark coil, $5.00. Claudius Burt, 102 Argyle Road, Ardmore, Pa.

WILL SELL $30.00 Receiving Set for $20.00. Range 1,500 miles on suitable aerial. Write. Leroy Martine, North Bergen, N.J.

HAVE—1 K.W. Sending Condenser, $8.00; 2 K.W. oscillation transformer, $8.00; marble switchboard with switches; electrical books; ¼ H.P. Ft. Wayne 60-cycle motor; Roth rotary converter, etc., for sale or exchange for No. 3-a loose coupler or magnet wire. Write for descriptions. Ralph Batcher, 131 Hyland, Ames, Iowa.

COMPLETE chemical outfit, High-grade C.P. chemicals. My large laboratory for sale at a bargain. Ralph Batcher, Toledo, Iowa.

FOR SALE—Wireless set, whole or parts. Send for particulars. Frank Plaisted, 142 Davis Ave., Brookline, Mass.

FOR SALE—Chambers 748 Loose Coupler in perfect condition. First check for $5.00 takes it. All other checks positively returned. Dean Carpentor, Westtown, Pa.

WILL EXCHANGE—One $2.50 Perikon detector and foot-ball for one new Murdock Loading Inductance. Stuart Terrill, Brookfield Center, Conn.

FOR SALE—Two complete receiving sets, $11.00 and $22. Write. Cromer Heitslin, Kissel Hill, Pa.

RECEIVER for spark or arc stations consisting of: $18.00 Chamber's coupler; double filament audion cabinet complete; 2,000 ohm phones, two months old, perfect condition. Also two military type portable telephones with buzzer attachment, good condition. What offers or exchanges? W. A. Brooke, 3127 North 13th St., Philadelphia.

FOR SALE—Receeiving Set, complete, with aerial and parts. Price $10.00. Schorr, 330 Essex St., Brooklyn, N.Y.

FOR SALE OR EXCHANGE—"Electro" High Tension Adjustable Condenser; "Electro" rotary Potentiometer; Radioson Detector with used cartridge; "Electro" Helix with pilot lamp. Want "Gernsback" or good 43-plate Variable. Cash for Variable. Louis Menier, 443 E. 85th St., New York City.

WANTED—¼ K.W. Packard transformer in perfect condition. State price. All letters answered. John Q. Adams, 5424 Fulton St., Chicago, Ill.

FOR SALE—Electric Therapeutic Apparatus or willing to exchange for a high frequency apparatus for a very reasonable difference. Kindly call at 364 West 67th St. or 113 West 63d St. on Sunday. John Ferguson.

FOR SALE—5-inch Induction Coil in fine condition, $20.00; new 6-80 storage battery, $10.00; 1/10 H.P. compound wound 110 V. D.C. motor, $6.00. Want 3A Kodak or Graflex Camera. W. S. Wells, 6626 S. Marshfield Ave., Chicago, Ill.

FOR SALE—Mignon RLC6 receiving cabinet, practically new, cost $75.00. My price $60.00. RJ9 Audion detector, never been used, $12.50. R. M. Richert, Statesville, N.C.

EXPERIMENTER—Until November fifth. $17.00 buys $27.00 complete receiving set consisting of Lightning Switch, Antenna Switch, Murdock 2,000 ohm headset, Arlington Loose Coupler, Turret Cup Detector with crystal, Precision loading coil, fixed condenser, fixed variable condenser and rotary variable. Each piece reliable. G. R. Campbell, 207 Grant Ave., Bellevue, Pa.

SALE OR EXCHANGE—Dynamo, ¼-inch coil, medical coil, magic lantern, Pony receivers, books, small phonograph. Want: 110 V. motor, Victrola, storage battery, tools, wireless sundries, etc. What have you in any line? Send stamp. Orville Huish, 140 Byron, Youngstown, Ohio.

WILL TRADE—Electric postcard projector with 110 V. bulb for ½-inch spark coil. Marion Miller, La Harpe, Kan.

BARGAINS—Instruments are practically new. Loose coupler, $5.00. Double slide tuner, $1.25. Detector, 75c. Money back if dissatisfied. G. M. Lesher, East Orange, N.J.

WILL EXCHANGE for wireless goods, a complete course of 20 lessons in Hypnotism with other scientific matter. A. Bozinsky, 339 E. 47th St., New York City.

FOR SALE—Brandes Superior single headset, $2.00; Amco ¼ K.W. closed core with primary variation, used one month, $10.00; small coupler, $1.00. Lee Hodges, 3408 Duvall Ave., Baltimore, Md.

GENERATOR C.P. 32 V. 20a direct connected to 2 H.P. Motorcycle Engine for good collection of U.S. and Foreign Postage Stamps. Petticrew, 133 Gunchel Ave., Dayton, Ohio.

WANTED—Best sending set for $10.00. Give description, range, amount used. Wm. M. Crane, Richmond, Mass.

AUDION AMPLIFIER—Good bulb, used 3 hours, cost $65.00. Sell for $35.00. Browne, 384 Mott Ave., New York City.

COMPLETE sending and receiving station, cost $52.45, practically as good as new; will sell for $35. Send for description. J. E. Matson, Neola, Iowa.

EXCHANGE—New "Electro" Transcontinental Outfit No. 1603. Want good typewriter. Forrest Elwell, De Veaux College, Niagara Falls, N.Y.

FOR EXCHANGE—Combination Edison fireside phonograph (new) and 45 four-minute records, value $35.00, for complete receiving set of equal value. P. B. Smith, 298 Bond St., Bridgeport, Conn.

WILL EXCHANGE—A complete "Telegraphone" talking and reproducing head for use in recording radio messages on a moving steel wire or band. Also a finely calibrated Keystone milliampere meter excellent for radio measurements. Will exchange the above for any of the following: A.C. or D.C. volt or ammeter, preferably of the Keystone or Weston make; small A.C. motor, ¼ K.W. transformer, or what have you? Samuel Cohen, 1936 Pitkin Ave., Brooklyn, N.Y.

RADIOSON DETECTOR, new, for sale. See description in Electro Importing Co.'s catalog. First money order for $2.75 takes it. Edward Jones, 522 Fairmont Ave., Fairmont, W.Va.

WILL EXCHANGE—New 6 volt 180 ampere Willard Storage Battery for De Forest Audion Detector, and Amplifier or Two Step Multi-Audi-Fone; must be in good condition. Have Type O Crystaloi Detector and Resonator, used two months, $2.00; Manhattan adjustable primary condenser, used two months, $3.00. What have you? Bruno J. Warsh, 718 W. 19 Place, Chicago, Ill.

FOR SALE—Ive's Electric train, $4.50; 40 watt Dynamo Motor, $4.50 (new), Baldwin Camp Lamp, $1.50, Steam Engine, $1.50. Might trade. William Van Akin, Liverpool, N.Y.

FOR SALE—Oliver No. 3 Typewriter, almost new, $23.00. Also have camera, photo, tent, rifle and watch at bargain prices. Joseph O. Berg, Hendrum, Minn.

FOR SALE OR EXCHANGE—International Correspondence School's course in arithmetic, also electrical books and apparatus, cheap. Alex. Serna, Lehigh, Okla.

FOR SALE—A first class Wireless Sending and Receiving Outfit. Two sending outfits, Erector set No. 4 and a Microscope Outfit. Make offer. Enclose 2c. stamp. John Houhy, Mattapan, Mass.

COMPLETE Wireless receiving outfit loose coupler; condenser; 2,000 ohm phones; loading coil; telegraph key and sounder, all for $7.00. Shartle, 575 West 172d St., New York City.

FOR SALE—Or will trade a 15 K.W. high voltage transformer with rheostat and switch board for a Hytone transmitting set. Write. Harry Cole, 1515 Linwood Blvd., Oklahoma City, Okla.

FOR SALE—Complete Wireless Outfit; ¾ K.W. Transformer, Clapp-Eastham Receiving Cabinet, 3,000 Ohm Phones. Cost over $75.00. Will sell for $45.00. Send for particulars. Harry Anders, Decatur, Mich.

FOR SALE OR EXCHANGE—Two absolutely brand new Electron Relay Bulbs, positively never used, each $3.25; 4 Bar Telephone Magneto and Case, $3.50; ¼ K.W. Gap, 40c.; Tillotson Telegraph Sounder, $2.00; Variometer (Home made), $1.24; E. I. Co. Fixed Condenser, 50c.; Rotary Gap Disk, $1.35; Helix (Home made), 12x12 inches, $1.50; two 60A600V SPDT slate base fuseless switches, each $1.00. All except switches prepaid. L. B. Stratton, Oneida, N.Y.

WILL TRADE—Smith Motor Wheel in good condition for ½ K.W. Sending Set, complete, with rotary gap. Vernon Wise, Butler, Pa.

FOR SALE—15,000 meter tuner, $10.00; telegraph set, $1.50. Other apparatus. Edward Silver, 264 West 57th St., New York.

MUST SELL—New Crystaloi detector type A, $1.75; E. I. Company Transatlantic 1,000 ohm phone and cord, $1.50; new 6 volt 60 ampere Willard Storage Battery, automobile, type, used two months, $9.80, cost $17.50; 1½-inch box type spark coil $5.60, cost $8.00; Hydrometer, 65c.; 6 volt 4 ampere Knapp dynamo motor, $2.90; Switchboard, 2 double pole switches, 2 single pole hard rubber switches, rheostat, ammeter. All very neatly mounted on stained wood base, $4.80; double pole double throw 30 ampere antenna switch, 90c.; electric thriller magneto shocking machine, 50c. All articles have been used only a very short time, have been well taken care of and are as good as new. Special $2.85 foot-ball without bladder, $1.45, used once, guaranteed good as new; Stevens .22 target rifle, $2.40, cost $4.75, used very little. Roy Sprecher, Lancaster No. 5. Pa.

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YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

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MARCONI—We have a limited supply of pictures of Guiglielmo Marconi that are done in sepia on fine India paper. Fine for decorating your wireless room. Ten cents each postpaid. Experimenter Publishing Co., 233 Fulton Street, New York.

PHOTOGRAPHY WITHOUT CAMERA—Novel social pastime, using photo paper invisibly prepared with interesting and artistic pictures. Samples prepared for 25 pictures with directions, 10c. Wedge Mfg. Company, "Km," Binghamton, N.Y.

WIRELESS

DOUBLE filament audiotron bulbs, $4.50 each. Full directions for making a Wireless Telephone given with each bulb. Leon Bartholomew, 313 Deyo St., Jackson, Mich.

STRANDED TUNER WIRE for receiving ARC and LONG DISTANCE—10 copper enamel wires covered with silk at 1c. per yard, 20 wires 2c., state whether No. 36 or No. 38 enamel wire is desired; discount on ½ and 1 pound lots. Special sizes to order. J. H. Claus, Hulmeville, Pa.

RADIO QUESTIONS answered, 3 for 10c.; 9 for 25c. Cat wiskers, 4 for 7c. Walter Patch, Ventura, Iowa.

TELEGRAPH—Morse and Wireless, also Station Agency taught. Graduates assisted. Cheap expense, easily learned. Largest school, established 42 years. Correspondence courses also. Catalog free. Dodge's Institute, Lone St., Valparaiso, Ind.

UNUSUAL BARGAIN—Rotary Converter operating on 110 volts D.C. and having an output of 85 volts, 11 amperes, at 60 cycles. Operates ½ K.W. transformer perfectly. Is unusually small; size 8½x9x11 inches; weight 64 lbs. Has regulating rheostat 12x13x6 inches weighing 29 lbs. and is an ideal equipment for experimental purposes. Price complete $35.00. Electro Importing, 236 Fulton St., New York City.

NAVY TYPE COUPLER and loading coil combined, $12.00; 2,500 meter coupler, $5.00; other bargains. Cliff Mfg. Co., Brookfield, Mass.

MOTORS—Rebuilt at extra low prices. 1/6 H.P. 110 V. D.C., $6.00; 40 Watt, $4.00. A. J. Temps, 1690 Grove St., Brooklyn, N.Y.

PHOTO SUPPLEMENT NUMBER

JANUARY, 1917

15 CENTS

The Electrical Experimenter

POPULAR ELECTRICAL NEWS ILLUSTRATED

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that the Radio Amateurs want to see the Commercial companies live and prosper.

A great many amateurs take up Wireless with a view of entering the service of commercial companies in order to make a living with the experience gained when they were amateurs. So, why should either they or we be antagonistic to the commercial field?

As far as the proposed new law is concerned it will be observed that it leaves things pretty much the same as they are now, both for the commercial companies as well as for the amateurs.

The new phase is found in those sections which will make it unlawful for foreign governments or their agents, or for foreign capital to plant Radio stations on our soil, which stations could violate our neutrality laws, as well as cause serious mischief in case we were at war with another nation or nations.

This was clearly demonstrated to our officials in 1915 when certain commercial stations had to be taken over by our Government because Secretary of the Navy Daniels had conclusive proofs that these stations could be used for transmitting or receiving un-neutral intelligence.

It will also be seen that the new law does not only aim at the foreign commercial Radio interests, but also at alien amateurs as well. In other words, should the proposed law be enacted, no foreigner would be allowed

In his letter to Capt. D. W. Todd, publisht elsewhere in this issue, it will be seen that the writer thought it advisable that certain additions be incorporated in the new law. The most important one being that amateurs should not be required to take out a license, if their stations were for receiving purposes only. This suggestion has been made for the reason that the present Radio Law is not specific as to that point. Altho several Government publications mention the fact that receiving stations require no license, the average man does not come to this conclusion by reading thru the Act. This has caused endless correspondence between amateur and Government officials as well as between amateurs and technical journals and Radio Apparatus manufacturers. The uncertainty of not being correctly informed has doubtlessly caused many would-be amateurs from entering the wireless field.

In his Editorial in the February, 1912, issue of *Modern Electrics* the writer recommended that the amateur should be restricted to a wave length of 200 meters and to a transformer input of 1 Kilowatt. This recommendation was incorporated in the Radio Act of 1912 and has proved satisfactory to all concerned. It is to be hoped that the present suggestion will be received equally well.

The Radio Amateurs over 400,000 strong is a unique American institution today. It should remain so.

H. GERNSBACK.

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THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

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The Radio Obliterator

It Spells Death to Radio-Controlled Devices.

WE are all doubtless aware of the wonderful results that John Hays Hammond, Jr., has achieved with his radio-controlled torpedo; in fact, the world has been so amazed by the performance that the United States Government offered him $500,000 for his device, it is said.

However, to an invention of this character there are always two sides. One concerns the merits and advantages of the invention, while the other considers its disadvantages and shortcomings. Insofar as the radio-maneuvered torpedo itself is concerned, this has proved in recent tests to possess, apparently, a marvelous and well-nigh uncanny sense of direction.

Attention is now directed, however, to the real efficiency of the invention when put to active service in time of war, when all the cunning and science of master technicians may be brought to bear on combatting such a demon.

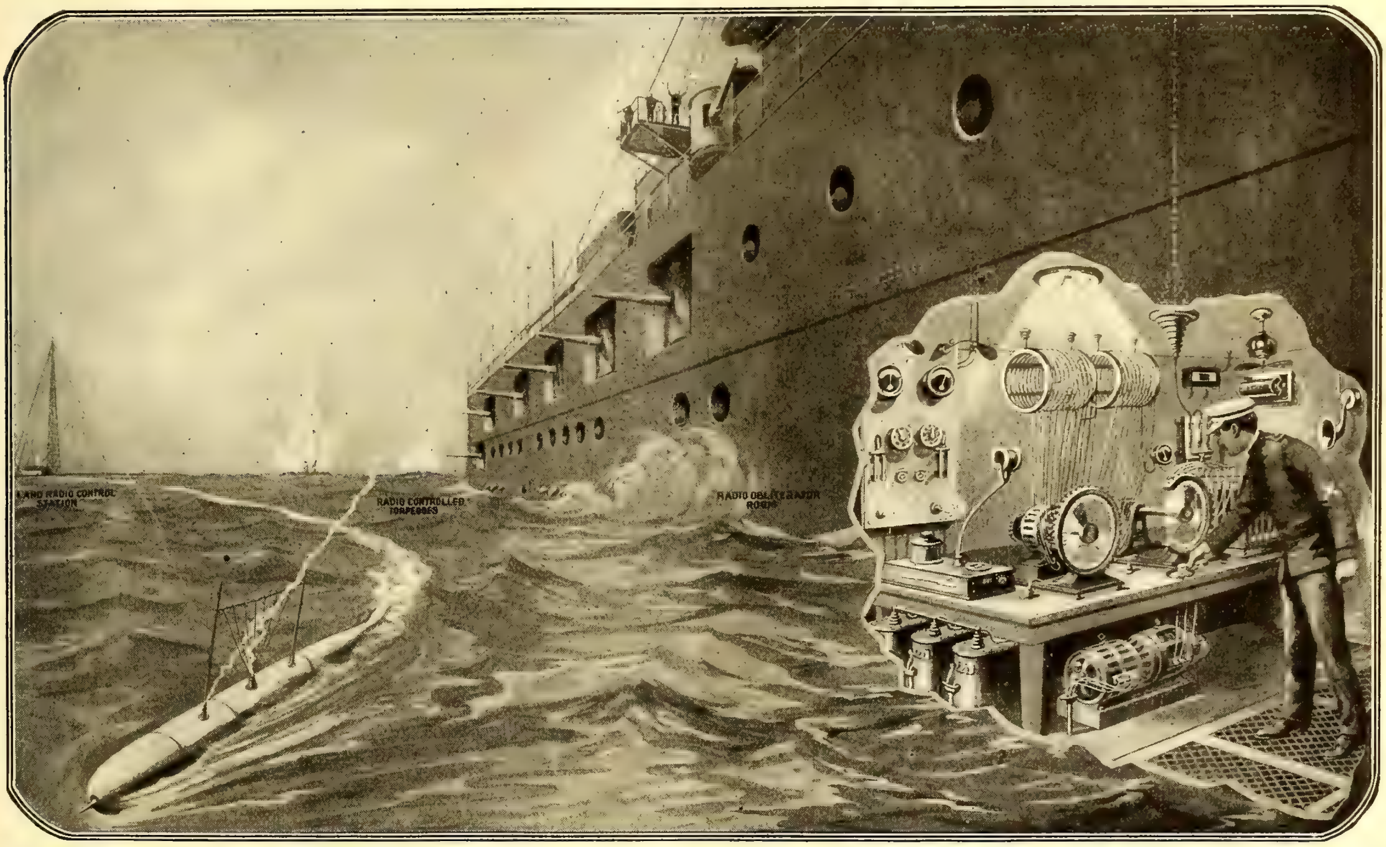
It has been noted as a natural stage in the development of military and naval machines the world over, that as soon as one nation has constructed a new and powerful weapon, then immediately some other nation will exercise every effort to construct a more powerful or combative defensive device. It might be assumed that this is an analagous case.

The Hammond radio-controlled torpedo has yet to meet exhaustive tests of external wireless interference. As an example: Let us suppose that a war-vessel discharges such a radio-controlled torpedo, and assume that the enemy ship has observed the dispatch of this deadly missile. Quite possibly it will know that the torpedo is of the radio maneuvered type and the officer on watch will immediately notify its radio operator, who, knowing his technique, causes his wireless transmitter to radiate a composite wave of many different lengths, thus destroying the effectiveness of the torpedo directed towards his vessel.

It has been learned from an authentic source that the above inventor is employing at present in his radio-controlled device a change in the wave length for controlling his missile, i.e., he employs a sensitive detecting device, tuned by suitable inductances automatically controlled by relays, which inductances control the wave length variations.

Assume, for instance, that the receiver is tuned to 600 meters to operate the explosive charge, 500 meters to start, 800 meters to steer to left, 1000 meters to steer to ·ight and 200 meters to go backwards. These wave lengths are then sent out by the transmitting station on land by merely pressing a certain key, when the impulse of the desired wave length is transmitted and the accurately adjusted receiver will respond to that certain wave length, thus causing the proper mechanism to function, which controls the vessel with perfect ease.

Now if we had a powerful radio transmitter device which would change automatically the emitted wave length from 100 to 10,000 meters, during say one minute, then the radio-controlled affair will be interfered with invariably, as its apparatus will act at every change of wave length, not permitting enough time to cause the con-



The Latest Marvel of Science, the "Radio Obliterator." It Radiates a Perfect Avalanche of Rapidly Changing Wave Lengths, which Spells Failure to All Radio-controlled Torpedoes and Similar Mechanisms, its Inventor Claims.

THOMAS A. EDISON IN HIS LABORATORY.

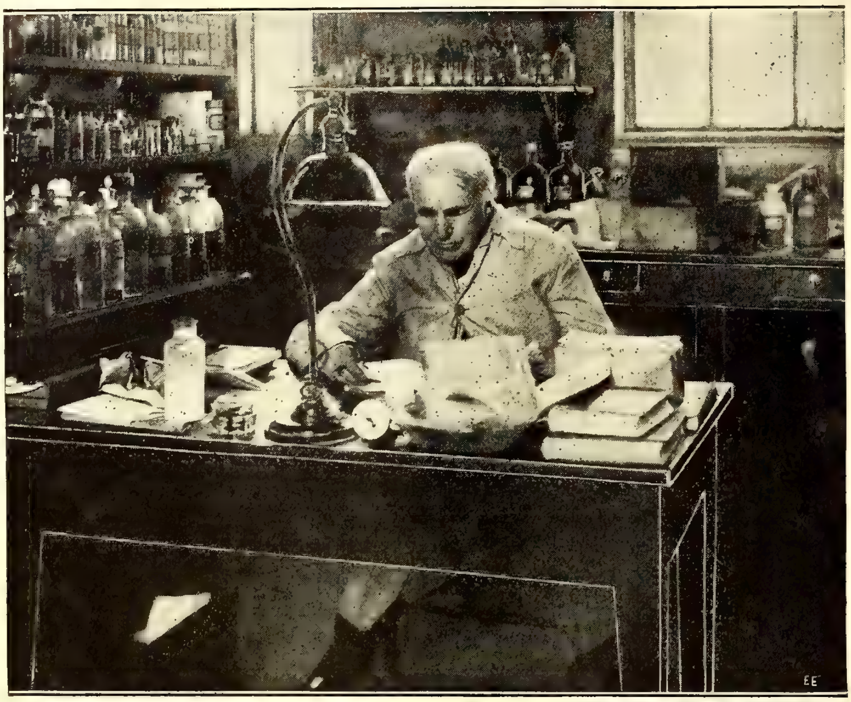
THOMAS A. EDISON, the well-known electrical inventor, is here pictured at work in his chemical laboratory. So vast has become the researches of this master investigator of electrical and physical subjects, that he has several laboratories in which he may drop at any time for a few hours or possibly a month's work. He is a persistent and indefatigable worker and pursues a particular problem unrelentedly until success seems assured.

Mr. Edison has been honored by many learned institutions and societies the world over and can exhibit when he so chooses, a very formidable array of medals and other symbols of honor.

Many anecdotes have been told about Mr. Edison and his distinct abhorrence to anything at all theatrical or artificial, for to those who know him best he is the soul of modesty.

An amusing incident of his social tendencies in this direction is cited by Frank Dyer and Thomas Commerford Martin, biographers of Mr. Edison.

On one occasion, receiving a medal in New York, Edison forgot it on the ferryboat and left it behind him. A few years ago when Edison had received the Albert medal of the Royal Society of Arts, a visitor at the laboratory asked to see it. Nobody knew where it was; hours past before it could be found; and when at last the accompanying letter was produced, it had an office date-stamp right over the signature of the royal president! A visitor to the laboratory with one of these medallic awards asked Edison if he had any others. "Oh yes," said he, "I have a couple of quarts more up at the house!" All this sounds like lack of appreciation, but is anything else than that. While in Paris, in 1889, he wore the decoration of the Legion of Honor whenever occasion required, but at all other times turned the badge under his lapel, "because he hated to have fellow-Americans think he was showing off." And anyone who knows Edison will bear testimony to his utter absence of ostentation. It may be added, that, in addition to the two quarts of medals up at the house, there will be found many other signal tokens of esteem and good-will—a beautiful cigar-case from the late Czar of Russia, bronzes from the Government of Japan, steel trophies from Krupp, and a host of other mementos, to one of which he thus refers: "When certain experiments with the electric incandescent lamp were going on at Menlo Park, Sarah Bernhardt came to America. One evening, Robert L. Cutting, of New York, brought her out to see the light. She was a terrific 'rubberneck.' She jumped all over the machinery, and I had one man especially to guard her dress. She wanted to know everything. She would speak in French, and Cutting would translate into English. She stayed there about an hour and a half. Bernhardt gave me two pictures, painted by herself, which she sent me from Paris."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A Recent Photograph of Thomas A. Edison at Work in His Chemical Laboratory.

"After years of watching the processes of nature," he says, "I can no more doubt the existence of an Intelligence that is running things than I do of the existence of myself. Take, for example, the substance water, that forms the crystals known as ice. Now, there are hundreds of combinations that form crystals, and everyone of them, save ice, sinks in water. Ice, I say, doesn't, and it is rather lucky for us mortals, for if it had done so we would all be dead. Why? Simply because if ice sank to the bottoms of the rivers, lakes and oceans as fast as it froze, those places would be frozen up and there would be no water left. That is only one example out of thousands that to me prove beyond the possibility of a doubt that some vast Intelligence is governing this and other planets." Thomas Edison is a true genius and scientist.

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trolling mechanism to properly operate and thereby altering the desired course of the boat or its performance.

It may seem impossible on first impression to build an apparatus for automatically changing the wave length of the transmitter at such a rapid rate as above mentioned, so as to emit different wave lengths and thus produce effective interference. Yet there are people who are working on the subject; notably, Colonel F. P. Cobbam, U.S.A., an engineer of national repute who has spent much time and money in developing his *Radio Obliterator,* an apparatus designed to interfere with any radio-controlled vessel or torpedo which is intended for use in modern warfare.

The U.S. Navy Department is making preparations for a complete test of this device in conjunction with the Hammond radio-controlled torpedo and if the latter will stand the test of Colonel Cobbam's *Radio Obliterator* the Hammond invention will undoubtedly be accepted as a successful and ingenious device.

Very little information can be obtained as to the technical details of Colonel F. P. Cobbam's *Radio Obliterator* just at present. The illustration herewith shows schematically a view of the necessary apparatus. It consists of large helical inductances with numerous leads connected to a rotary switch mounted upon a shaft and revolved by a motor. In front of this inductance a movable contact might be placed so as to press against the convolutions of the inductance, and as the inductance is revolved this contact could be caused to move from left to right and from right to left. As the movable contact moved in or out the inductance effect of the coil would be changed, thus changing the wave length emitted by the transmitter.

On the same shaft or geared to it, as shown, a suitable automatic switching arrangement is connected which changes simultaneously the condenser capacity, which also helps to change the wave length. The exciting apparatus consists of large, high tension transformers, connected in the usual way to the alternating current supplied thru special protecting devices.

Colonel Cobbam's device has been so cleverly designed that the wave length radiated can be changed from 100 meters to 10,000 meters in the space of one second! The time taken to change the wave length can be increased by reducing the speed of the motor driving the inductance and capacity switches. Thus, by merely controlling the speed, the wave length corresponding to that of the torpedo can be ascertained sooner or later which will interfere with the radio-controlled weapon and render its effect nil.

Mr. John Hays Hammond, Jr., claims that no outside radio interference can affect the journey of his vessel or torpedo, and he further states that if a hostile vessel attempts to interfere with his boat that the latter will immediately turn in the direction of the enemy. That sounds bad for the vessel fitted with the new device, if it fails to obliterate—but we shall see.

Mr. Hammond employs, among other things, a time relay for controlling his vessel, thus eliminating most all ordinary radio interference. But the wave length emitted by the Cobbam *Obliterator* can be changed in a fraction of a second to any wave length desired; and at the same time the wave length is automatically changed from a low time value to a very high time value and vice versa, thus a point is sure to be reached, it seems, where the *Radio Obliterator* will strike a wave length and duration of time corresponding exactly to that of the time relay. This causes the desired interference.

We must wait and see the result of the Hammond radio-controlled torpedo when tested with the Cobbam *Radio Obliterator*. A number of the leading radio and electrical engineers of the country have cautioned the U.S. radio experts not to close their tests on any form of radio-actuated device or torpedo until it has absolutely showed that it can withstand the perfect onslaught of wireless waves of every conceivable magnitude hurled at it by the Cobbam machine. The editors have seen these papers and are heartily in accord with the caution note which they sound. There seems a strong probability that we shall presently see a radiodynamic torpedo doubling back on its course and possibly blowing up either itself or its base control plant.

Moonlight on Tap

By Leigh Danen

MOONLIGHT, clear and silvery, is on tap at any time in the Italian garden of James L. Breese, at Southampton, L.I. It can be turned on, by pressing an electric button, any night thruout the year, even rainy ones. Mr. Breese no longer has to depend up on the vagaries of Luna to flood with light his sunken garden, or to add a weird beauty to its wilderness of shrubs and vines and profusion of fountains and statuary.

A new and untried field has been opened up by this wonderfully effective artificial moonlight, that of landscape lighting. While stage, studio, interior and decorative electric illuminating effects have been developed to a high state, this is the first example of permanent, artistic outdoor lighting on a really large scale.

Electric lamps totaling more than *half-a-million candle-power* have been skilfully concealed about the Italian Garden. Numerous sets of dimmers and color screens for them have been worked out; and special glass reflectors coated with pure silver were designed.

While the area covered by this novel system of outdoor illumination is half a mile long, the cost of the experiments including the permanent apparatus has been less than a thousand dollars. By following the methods successfully developed at Southampton, anyone sufficiently interested in this untouched field should be able to try it on a small scale at a very moderate expenditure.

The Italian garden of Mr. Breese is in the shape of a rectangle; the long sides of which measure half a mile and the short sides about a quarter of a mile. The porch of the dwelling marks one of the shorter sides. There is an inner garden, starting at that point and stretching a quarter of a mile, which is bounded by pergolas ten feet high, on its three remaining sides. Close to the house is a playing fountain; the entire garden is bisected by a long walk, and at the far end, is an urn, which indicates the boundary of the estate.

The wonderful tricks, the delicate traceries of light and shadow, the beautiful contrasts which real moonlight brought out in the Italian garden had long been a source of astonishment to the owner's guests; and he decided to attempt to utilize the hidden charm of the garden at all times.

Of course it was impossible for the experimenters actually to imitate moonlight. So, they worked with a view to create an illusion which would suggest it to the beholder, by reproducing a similar diffusion of light by artificial means.

To analyze moonlight and find out its chief element was the first task. Contrary to popular belief moonlight is not blue but a *white* light of low intensity; the bluish tint is the result of the diffusion of the light. If a piece of white paper is held up to moonlight, it will show white with a slight grayish cast. That is because every light is governed by its reflecting surface and the moon being a dead body is gray.

The innovators soon discovered that if they threw a blue light, such as is used to suggest moonlight in a theater upon the vines and shrubbery, their daylight green was merely darkened and very little illumination was secured. This is because foliage absorbs less than 5% of the light which strikes it.

But if a soft white light, with most of the yellow eliminated, was cast on the greens, an illusion of moonlight was obtained, altho highlights and shadows were slightly over-accentuated.

On the pergolas a white light looked crude and stagy, but blue produced the wanted effect; while on the statuary, opalescent lights produced varying, shimmering contrasts.

The next step was to create the desired moonlight illusion in the garden in its entirety. Beautiful effects had been obtained at isolated spots but no harmonious blending results had been secured. To accomplish this powerful electric lamps were placed on the roof of the porch of the house and on top of the pergola.

It was very important to place them high up so as not to impair the vision of spectators, going in the direction from which the light was cast. Those on the porch are thirty feet from the ground; and those on the pergola, ten.

Three lamps casting white lights were set over the porch, one in the middle and one on each side; in each of the adjoining pergolas a blue light was placed; and a white one on top and at the center of the opposite pergola. They are nitrogen filled bulbs, each of 67,000 candle-power, giving a total illumination force of 402,000 candle-power.

The center lamp floods the long walk which runs through the center of the inner garden; and the lamp on the opposite pergola takes up the illumination at that point, bathing with a soft light the remainder of the walk, as far as it goes.

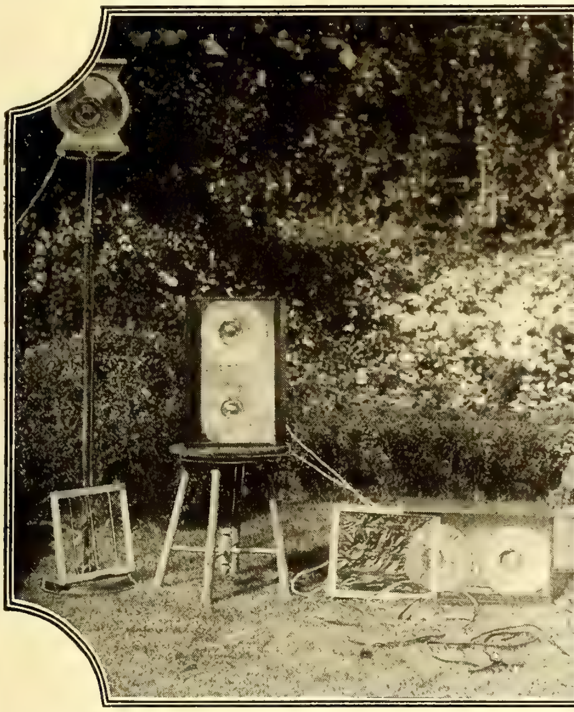
The lamps on both sides of it also are focused on the inner garden and are pitched at a downward angle to cover all the foliage, while those at the entrance to the pergolas throw blue horizontal rays across the marble pillars and walks. All of the lights are adroitly masked from view behind masses of foliage and greens.

On two sides of the playing fountain near the house are batteries of lights, each of two lamps. And at the urn at the far end of the long walk is a similar battery of lights. They also are nitrogen filled bulbs, each of 25,000 candle-power—a total of 150,000 candle-power.

By means of dimmers and color screens, these lights are made slowly and subtly to change colors, which vary all the way from green, pink and amber to purple and blue. Thus warm, delicate colors are turned on the statuary, greatly enhancing their beauty.

For some time, the experimenters had great difficulty in finding a suitable and serviceable reflector. Ordinary mirrors coated with mercury were tried, but the heat generated by the lamps heated the mercury to such a degree that it evaporated; also, the glass of the reflector melted and once the bulb itself became so

(*Continued on page 671*)



"Moonlight on Tap" Aptly Describes the Electrical Illumination Features Just Completed on the Estate of James L. Breese, at Southampton, L. I. Electric Lamps Totaling More Than Half-a-Million Candle-Power Have Been Skilfully Concealed About the Italian Garden.

Illustration (at left) Shows Some of the Special, Silvered Glass Reflectors and High Candle-Power Nitrogen Lamps. That Below Gives Some Idea of the Excellent Imitation of Actual Moonlight Effected. No Direct Glare is Visible Anywhere.

How Electricity Helps to Mine and Purify Gold

GOLD! The magic word that has charmed mankind since prehistoric ages. Even when it was not used as a means of payment for man's debts, it was revered by all from the priest to the peasant for its wonderful qualities, and we find evidence of its being used in decorating the finest palaces and public buildings of ancient times.

To-day, the average person handles but very little gold, and this is mostly in the form of jewelry. Gold coin, at least in America, is seen but seldom, especially in the Eastern states, altho there is a very large quantity of it in use for the payment of banking transactions, etc.

Electricity helps enormously, and in many cases proves invaluable, in the many diversified operations attending the mining, transportation and refining of gold. The accompanying illustrations are unusually interesting as they show actual views of gold producing and refining operations.

It is indeed surprising to learn that the spirit of electricity has permeated the freezing cold of the Klondike gold country.

This brings to mind one of the new wonders of civil engineering in the far north where "Jack Frost" is king. It is the invention of Joe Boyle, by which he keeps his big hydro-electric plant at Boyle Creek, Klondike, running right thru the winter, and that notwithstanding the temperature at times falls to 70 degrees below zero! It is so cold there in the winter that if you should attempt to run a spraying machine such as is used in an orchard the water would turn to snow before it fell to the ground. The thermometer keeps down to zero, or far below that, for the most of the winter, and after the cold weather sets in the land is ice-locked until spring. Some of the streams have seven feet of ice over them, and many freeze solid. Nevertheless, Mr. Boyle has been able to turn a branch of the Klondike River into a great ditch six miles in length and drop it down upon turbines with a fall that creates electricity to the extent of 10,000 horsepower—day in, day out, the year thru. The amount he is actually using is only 3,000 horsepower, but the equipment is such that it could be easily increased by the addition of more units.

There are many electric plants of this kind in the world, but none which are moved by water having such temperatures as freeze the soil and gravel everywhere to a depth of seven feet, or where the river runs above strata of perpetual ice. How did Joe Boyle solve the problem? He did it by marrying the common horse sense for which he is noted to his genius for practical invention. He knew that the waters of the Yukon and the Klondike flow under the ice all winter long and that there is a space between the water and the ice overhead.

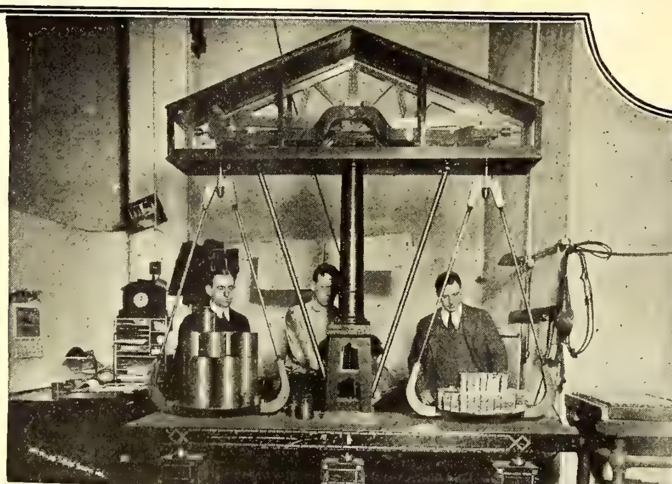
He concluded that it was this dead-air space that kept the running water from freezing. He fills his ditch to the top and allows nature to freeze a sheet of ice a foot or so thick upon it. He then drops the water for a depth of two feet and has still a running stream of four feet or more farther down. The dead-air space above keeps off most of the frost, and in order to add to the heat, he installs *electric heaters in the bed of the stream,* which aid in keeping the water from freezing (see illustration). These heaters each represent units equaling about 100 horsepower. There are comparatively few of them in the six miles of ditch. They do

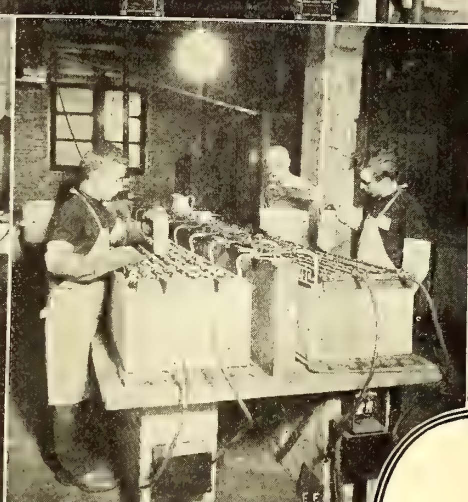
(*Continued on page 687*)

(Top)—Weighing New Gold Bricks on the Giant Scales in the U. S. Assay Office at New York, Which Weigh from One One-hundredth of an Ounce up to 12,000 Ounces.

(Lower Views)—Gold and Silver Slabs in Raw State Being Reformed Electrolytically Into a Pure State. Powerful Electric Currents Circulate Thru Acid Solutions, Carrying the Fine Gold or Silver Particles from a Low Quality Bar to a Deposition Bar. Porcelain Tanks Are Used for This Work.

To Visit the Assay Office Is to Bring Back the Days of King Midas and His Much Hoarded Coin. Every Corridor and Passageway Is Stackt Man High with Gold and Silver. In One Day There Was Received a Deposit of $37,500,000 in Coin.

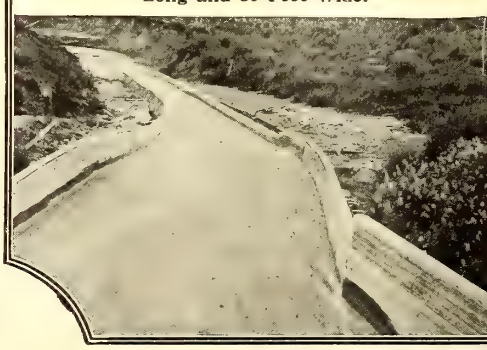


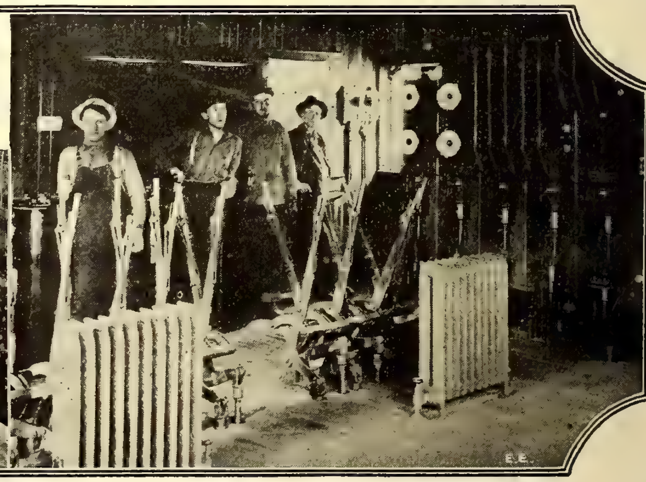


Photos (c) Press Illustrating Service

(Right)—View Inside Giant Electric Dredge Used in Mining Vast Gold Deposits of the Klondike, Where Zero Weather Is Common.

Electric Heaters Prevent This Klondike Gold Mining Stream from Freezing. It Is Six Miles Long and 30 Feet Wide.





Photos from F. G. Carpenter

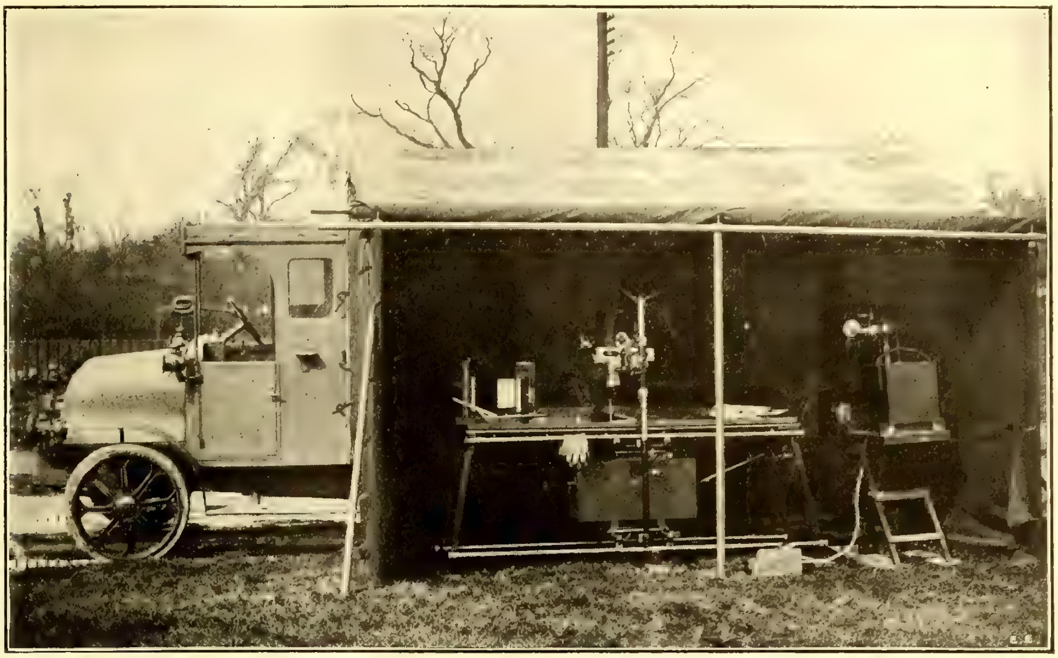
A Complete Portable X-Ray Plant Used by European Armies

WHEN the English, French or Russian soldier is put out of commission by a sharp-nosed German bullet or a shrapnel splinter, he has one thing to be thankful for in most instances. That is a well organized and equipped hospital corps who, by means of their highly efficient X-ray outfits, can locate most anything in any part of the human body. You are on the firing line banging away with your magazine rifle at the skull of a German officer when zing—you feel faint and drop in your tracks. The light of day fades away and when you at last gain consciousness it is to find yourself strapped to a massive table fitted with a score of handles, rods, and what not. It is the X-ray room of H.M. Medical Corps, a short distance back of the second line trench. They found it—a bullet that just missed your heart. Such an experience occurs hundreds of times daily on European battlefields.

Here we have a photo of one of the finest portable X-ray outfits supplied the British and other allied forces for field operations. These wonderful outfits are veritable traveling hospitals.

The complete dynamo generating set, which is exceedingly compact, occupying a space of only 3 feet by 2 feet by 3 feet, comprises a single-cylinder gasoline engine developing 1.5 horsepower at a speed of 1,300 r.p.m., radiator, muffler, gasoline tank, dynamo and switch box. The whole is enclosed in a wooden box provided with carrying handles and also with a receptacle for the necessary tools.

The dynamo or generator is mounted at the side of the engine on an extension of the crank case. It is of the reverse compound-wound type, having an output of 10 amp. at 70 volts, and is directly driven by the engine. The latter is put in operation by means of a pulley on the rear end of the dynamo spindle, the necessary initial impetus being given by a strap working on the pulley. In order that the engine shall run at a constant speed, it is fitted with a centrifugal governor, which acts on the throttle valve in the carburetor.



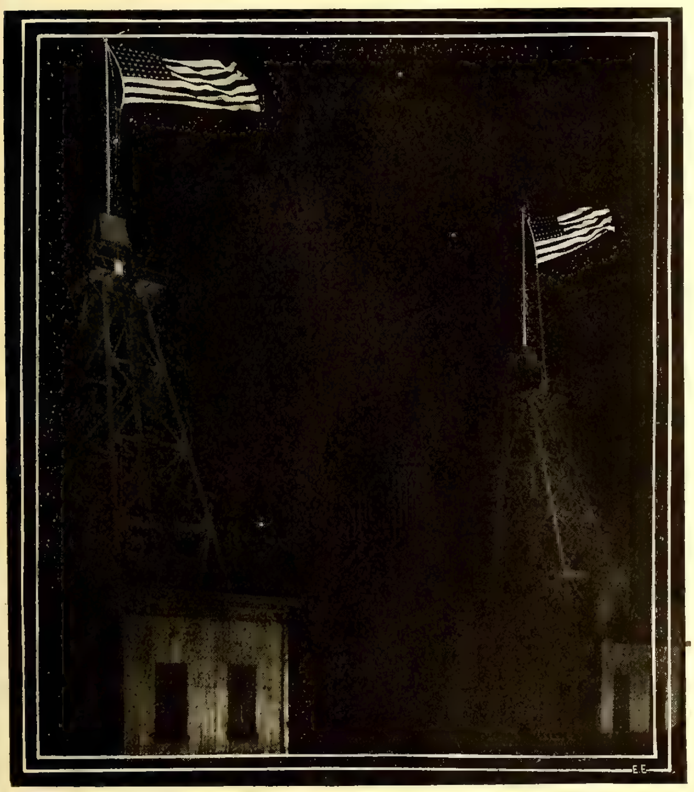
One of the Magnificent Portable X-Ray Outfits in Use by the Allies on the Battle-field. It Includes a High Power X-Ray Tube and Coil which Receives Current from a Special Dynamo Driven by the Gasoline Engine.

The switch gear, which is entirely enclosed in an aluminum case mounted above the dynamo, is of the rotary type and furnished with outside operating handles. It is arranged to give any of the following combinations: (1) Off position, (2) battery to X-ray coil, (3) battery charging and dynamo and battery in parallel to X-ray coil, (4) dynamo and X-ray coil only, (5) battery and dynamo in series to X-ray coil. The voltages to the coil are approximately: No. 2 position, 36 volts; No. 3 position, 36 volts to 45 volts; No. 4 position, 75 volts, and No. 5 position, 110 volts.

The X-ray bulb supplied is sufficiently large to permit of taking radiographs through the thicker portions of the body. This X-ray outfit complete on its chassis was built by the Austin Motor Company, Ltd., of Birmingham, England, to whom we are indebted for the photograph here reproduced.

ILLUMINATED FLAGS ECONOMICAL ADVERTISEMENT.

Illuminating the flag that ordinarily flies at the masthead during the daytime is one of the latest and happily a very economical method of advertising your factory, office or other place of business.



One of the Latest Advertising and Decorative Schemes Is to Illuminate Your Flag at Night. The New "Flood Lighting" Is Utilized in the Present Instance with Highly Effective and Economical Results.

Two flags on the generating station of the United Electric Light & Power Company, New York City, are flood-lighted nightly and can be seen for several miles in each direction. Each flag is 15 feet long and is illuminated by three 500-watt, Type C, concentrated filament tungsten lamps, mounted in reflectors 120 feet distant from the flag. Three reflectors are placed directly in front of each flag, two serving to illuminate the flag immediately in front, while the beam from the third lamp is turned across onto the other flag. The flags are lighted at sunset and remain illuminated until midnight. Hundreds of people see these flags each night, and the favorable comments that have been received from civic and patriotic organizations indicate the large amount of interest shown by the public.

Many hotels in the large cities find this a novel and efficient means of attracting attention to their hostelry. One of the largest hotels in New York City utilizes a small electric searchlight, the beam of which creates a very mystical effect, as it lights up the American as well as the hotel flag. A white flag for the latter shows up best, with the hotel name spread across it in black letters.

THE PARIS TELEPHONE SYSTEM.

An appropriation of $24,000,000 has been asked of the French Parliament for improvements and extension of the telephone system in Paris. Six large new exchanges will be established. The three existing exchanges will be enlarged and new multiple switchboards for 12,600 lines installed. Long distance underground lines will also be laid.

There are nearly a thousand electric ranges in use in the city of Winnipeg, Can.

Illuminated American Flag Protects Ocean Travelers

THOSE who have had to travel across the Atlantic Ocean during the past year or two have experienced many sleepless nights when the least sound caused them to think invariably of a submarine attack.

The photograph here reproduced of the Hawaiian-American liner *Kansan* was taken upon her arrival at Boston, after having been held up by the German submarine "U-56." The *Kansan* was the first ship stopt by the German under-sea raiders. She was en route from New York to Boston and thence to Europe under charter to the French Government.

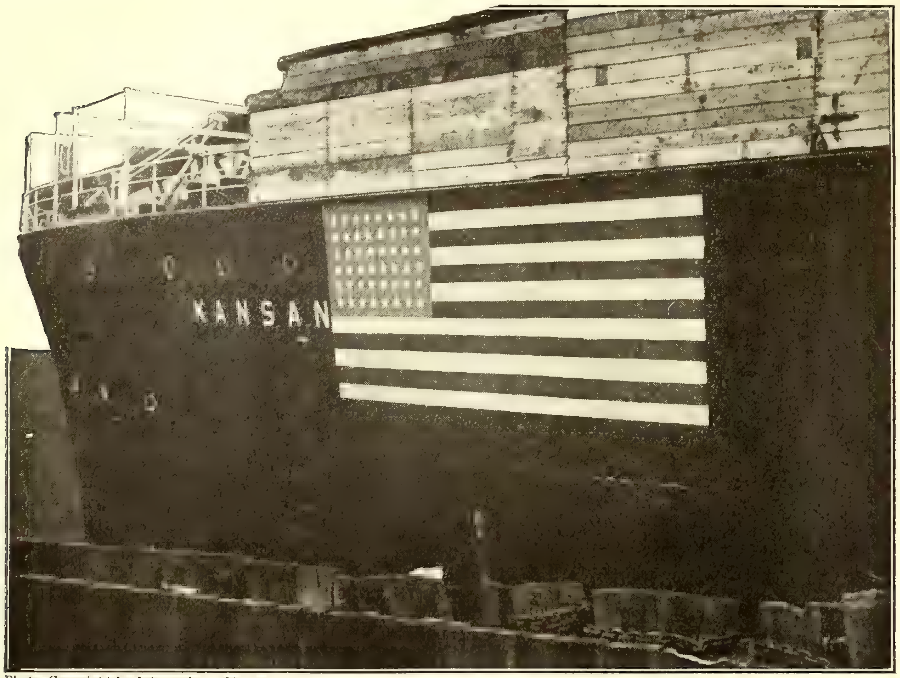


Photo Copyright by International Film Service.

The Photo Shows the Hawaiian-American Liner "Kansan" Upon Her Arrival at Boston, After Having Been Held Up by the German Submarine "U-56." The American Flag Painted on the Hull Is Illuminated at Night by Powerful Electric Lights.

The accompanying photograph, as well as our front cover illustration, show graphically how the American Flag on the Hawaiian-American steamship *Kansan* has been advantageously used for the protection of neutral ocean travelers.

As seen the replica of the United States flag in this case is painted on either side of the steamship and powerful electric lamps and reflectors are suitably arranged so as to cast their rays on the painted flag at night.

All thru the darkest nights the steamship is thus protected from untoward attacks by surreptitious U-boat commanders. As will be remembered, there are a number of instances on record where harmless vessels have been fired upon and even sent to a watery grave by belligerent submarines, and the after plea has, in a number of instances, been that those on board the submarine craft were afraid to venture very close to the unknown steamship for fear of being fired upon; and also, the argument has been raised a number of times by the attacking submarine officers, that they could get no reply in any way to their wireless or megaphone queries.

However, this scheme, utilizing the immense painted flag on the hull of the vessel, illuminated at night, would seem to be a very sure manner of indicating to any submarine commander as to just what ship he was dealing with. This idea has been effectively employed by several other neutral powers for the protection of their merchant marine craft and very little trouble has ensued since the adoption of this plan.

The flag painted on the side of the ship is not only effective at night, but also in the day time, and if the various countries would follow the principles of international law and refrain from making improper use of this effective insignia, it would seem a very practical and sure means of saving many lives.

STORAGE BATTERIES IN MODERN SUBMARINES.

The present illustration shows the large storage battery installation on one of the latest submarine fighters—the *Isaac Peral* of the Spanish Navy. This vessel was built in the United States and represents one of the very latest ideas in submarine boat engineering. The precautions taken to carry off all the gases generated when the batteries are working is apparent from the size of the large vent pipes in the photograph. Each battery cell has a small size vent pipe leading off into a large central tube.

The *Isaac Peral* is the latest and most modern submarine built for the Spanish Navy by an American concern. The photograph was taken during the trial trips off Provincetown. The undersea boat can submerge in one minute and come to the surface in one minute and a half. It can submerge to a depth of 400 feet, altho the guarantee only calls for 200 feet.

The boat has two periscopes. It is electrically steered; when traveling on the surface the navigator works from the bridge, and while traveling submerged, he can either operate from the conning tower or from below. The submarine has a cruising radius of 8,000 miles and can easily cross the Atlantic and back again without refueling. It carries a crew of twenty-two men and two officers. While making a submerging test, it was demonstrated by the amount of air used, that if necessary, the crew of twenty-four men can live in the submarine submerged for forty-five hours. According to eye-witness descriptions, the now famous *Deutschland* and *U-56* are almost exact duplicates of the *Isaac Peral.*

The switchboards installed in the submarines for controlling the charging current of the storage batteries and the transposition of the dynamo-motor connections are very elaborate altho marvelously compact ones, and to visiting "land-lubbers" prove a most interesting and startling innovation in switchboard design.

The storage batteries are charged when the sub-sea fighter travels on the surface of the waves, the oil engines driving the dynamo-electric machines so as to cause them to generate sufficient current for charging purposes. As soon as the vessel dives, the engines are cut out and battery current is switched on the dynamos, which now operate as motors for driving the propellers.

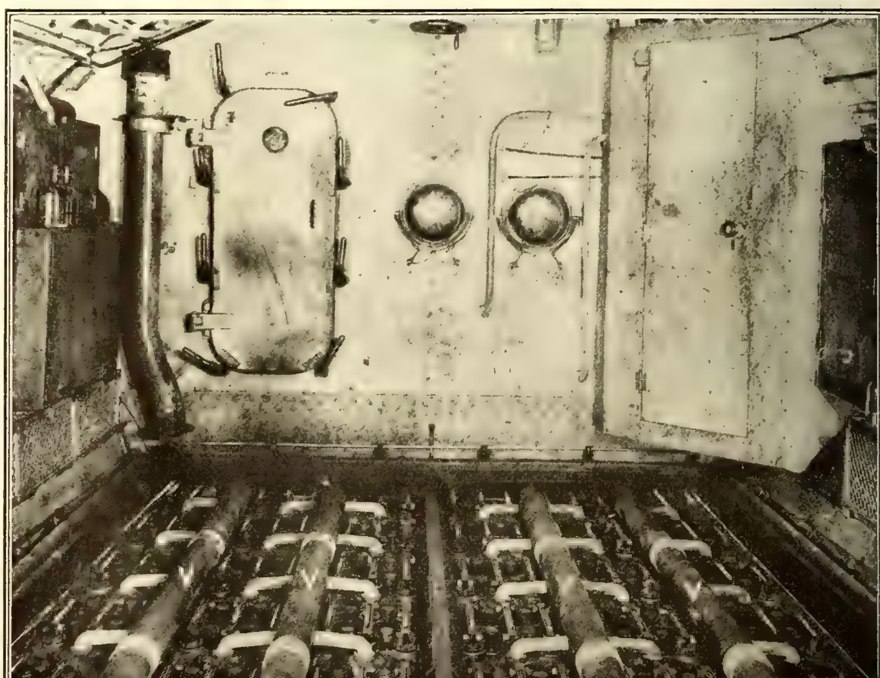


Photo Copyright by International Film Service.

What the Interior of a Recently Built Submarine Battery Room Looks Like. Note the Vent Pipes "V" Designed to Carry Off the Dangerous Gases from the Battery.

How Electricity Produces Mystery in the Movies

Electricity is playing a very important rôle in the moving picture art. So much so, that without the use of this mystifying agent, it would be difficult, if not quite impossible, to stage our modern scientific moving pictures, which show so realistically such wonderful thunder storms, radio controlled torpedoes, mind-reading machines, and hundreds of other possible and impossible creations of the human brain.

Many of us have had the pleasure of witnessing the spectacular photo play "The Black Box" in which the most wonderful electrical displays were exhibited. The illustration shows one of the detectives, in this absorbing screen story, making a test in his laboratory, also his two female assistants. This room is elaborately equipt with a startling galaxy of electrical instruments and two high-frequency machines, one of which is a large Wimshurst static machine, seen at the left. A mammoth Tesla high-frequency transformer appears in the background. The high tension current supplied to the primary of this coil is obtained from a large alternating current, step-up transformer, and is past thru a rotary spark gap. The leads from the half-million volt Tesla coil are connected to various different apparatus stationed about the laboratory.

One that may be particularly noted is the rectangular screen. This consists of a long copper wire wound between two glass rods and when properly excited by the Tesla transformer it produces one of the most spectacular effects imaginable. A powerful discharge appears on the various sections of the wire and the whole effect seems as if the entire instrument is enveloped in flames. Two large Leyden jars are used for the condensers, one of which is seen to the right of the door.

Radio apparatus has again been featured in one of the latest serial photo-plays entitled "Liberty," produced by the Universal Film Company. This scene shows one of the duly uniformed Army Officers receiving an important message *via radio* from one of the commanding officers on the firing line. The large armored motor car seen in the immediate back-ground whirls away at terrific speed as soon as the word is received by the radio operator.

Spat! Spat! Sings the Mighty Spark of the Wireless in This Latest "Battle Scene" from the Exciting Film Play, "Liberty." Yes, It Looks Like the Real Thing.

FOR THE WOMAN WHO COOKS BY ELECTRICITY.

The woman who cooks with an electric range for the first time should be given careful instruction in its use, for the arts of cooking by electricity and cooking with coal differ widely. An electric-range manufacturer offers the following excellent suggestions for conserving the consumption of electricity which apply to almost any type of electric range.

In boiling operations, bring liquids to boil on *full* heat. Then switch to *low*. This cuts down the current consumption by three-quarters—an immense saving. *Low* heat will keep the water boiling.

Do not allow liquids to bubble-boil. This is entirely unnecessary. By so doing you are merely turning the water of the liquid into steam, where it is wasted. No matter how much current is applied, the liquid cannot be made hotter than the boiling point.

Many housewives believe that the food is not cooking unless the water is bubbling furiously. This is a mistake. If the water is steaming it is hot enough to do the work, and current is saved.

Turn current entirely off about ten minutes before thru boiling. The heat stored in the unit will keep the liquid at the boiling temperature for the remainder of the cooking operation.

Use flat-bottomed utensils, preferably those made of steel or aluminum. These are to be preferred to poreclain ware, for they conduct the heat better.

Do not use too much water. This is extremely important. It requires a lot of electricity to heat the extra water and this heat is usually wasted.

In cooking vegetables, these need not be submerged in the water. The steam will do the cooking. For instance—in boiling eggs—use only enough water to cover the bottom of the vessel—generally about half a cupful. This amount of water is quickly boiled and the steam does the cooking.

The same principle applies to any boiling operation. Put a cupful of water on potatoes and watch the result.

Boiling is the most expensive operation performed on the electric stove, and the above instructions, carefully followed out, will cause a material saving in your bill for electricity.

Do not heat a gallon of water if you need only a pint.

The oven is the most economical part of the stove if properly used.

Do not use water in roasting, as it is entirely unnecessary. The electric oven is an air-tight fireless cooker, and the natural moisture of the meat is not evaporated, but is retained.

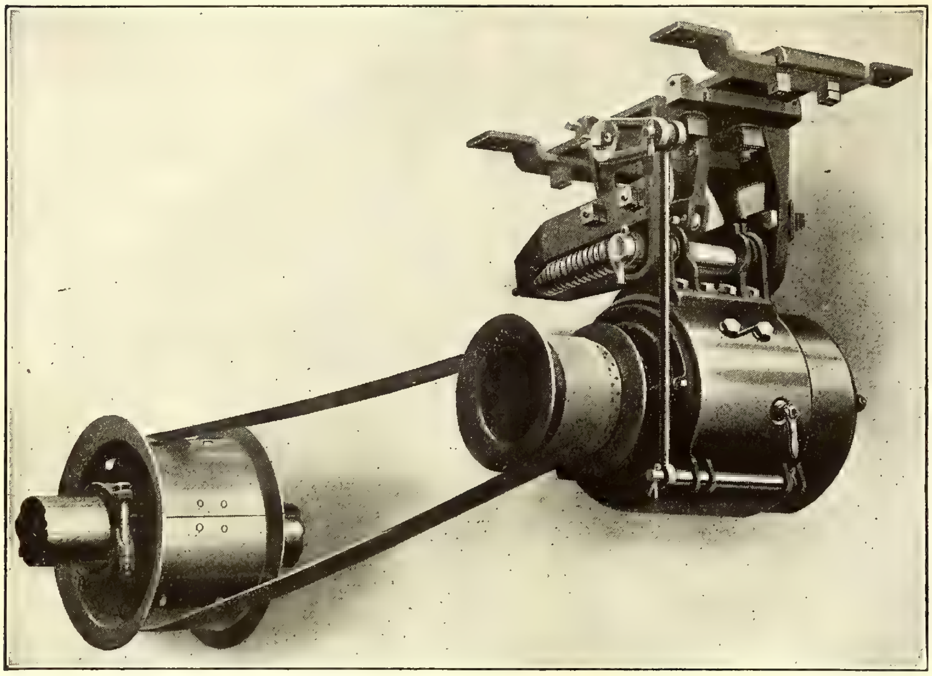
When placing a roast in your oven, see that the indicator registers the proper temperature. After the roast has been in for about ten minutes, turn the current off. Do not open the door, but permit all the heat to remain inside the oven. Allow 15 minutes to the pound for cooking.

One of the Best Electrical Laboratory Scenes Ever Produced—A Moment from the Screen Play, "The Black Box."

How Railroad Trains Electric Light Themselves

WHEN you ride in an up-to-date railroad train at night you invariably notice the electric illumination. Once—in our grandfather's day—it was produced by the evil-smelling oil lamp. Then we had, and still do have to some extent, the gas lamp supplied by a high pressure gas tank supported under the coach. But today we find all the best railroad passenger coaches equipt with electric lights. Possibly you never stopt to philosophize regarding this every-day convenience.

Let us consider then the three known general methods of securing electric light on railroad cars. First, there is the straight storage system, in which a car carries a very large battery so as to receive at the terminal charging station a sufficient charge of electrical energy to last to the next charging station. This means hauling excessive weight and switching of cars onto charging tracks and holding them there for the hours of charging which each trip demands. This system interferes either with normal car movements or with proper charging of the batteries or with both. The exigencies of railroad operation are such that one can hardly count on proper charging under such conditions. It takes just so many hours to charge a battery right. To force the charge inevitably damages the battery and such damage is hardly avoidable with the straight storage system.



As You Speed Along in a Railroad Car One of These Busy Little Dynamos, Belted to the Car Axle, Is Pumping Electricity Into the Lamp Circuit and Into a Storage Battery for Stand-still Lighting Later.

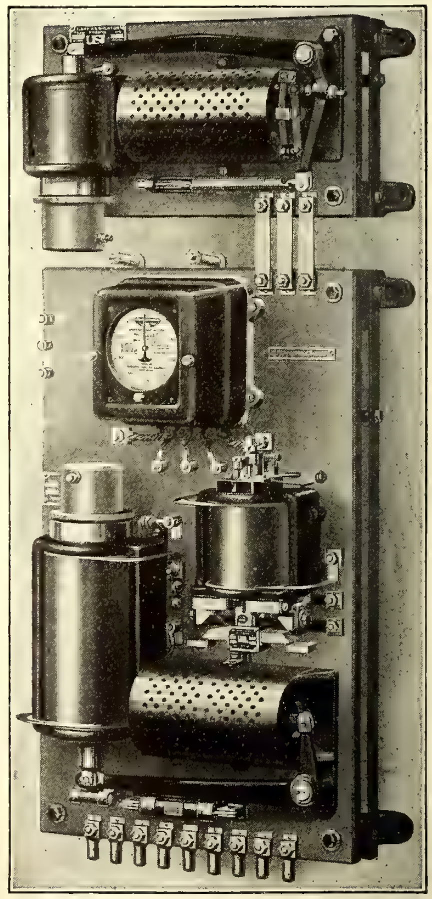
Then there is the head end system with a special electric generating equipment on board the train supplying the lighting energy for the cars trailing behind. There are several objections to this system such that it has but few installations.

Against both of the foregoing systems the axle-driven unit system in which the dynamo is driven from the car axle by a belt has steadily gained favor in the past few years, because it has gradually attained to the operating perfection of an up-to-date stationary electric plant.

The axle-driven unit system makes each car an independent unit, which goes about its own business, charges its own battery *en route* and is in every way sufficient unto itself. The operating department handles cars and trains oblivious of lighting problems—it has but to couple the cars and air hose. There is no special switching of cars, no interference, and no delay.

The improved axle car lighting system here illustrated charges its battery perfectly—attaining a result hardly to be hoped for in the terminal charging scheme. Furthermore, the generator does all the work, that is, carries whatever lamp or fan load may exist, all the time that the car runs at generating speed. During this generating time the battery rides as a passenger, does no work, and receives automatically, in an ideal manner only such charging as it requires. The principle involved in this particular design utilizes the axle energy every moment it is available and works the battery only when such energy is not available. For this reason the axle drive system can accomplish its ends with a battery of the lowest capacity and therefore of the smallest weight and cost practicable.

The illustrations herewith show how the enclosed dynamo is mounted under the train and belt driven from split steel pulley clamped on the main axle. Note the holes in the dynamo pulley—these help to make the belt drive more steadily, as otherwise there are apt to be air pockets formed between the moving belt and the pulley face. The feed wires from the dynamo lead to the automatic switch-control panel here shown. This contains the necessary cut-off relay to open the dynamo circuit when its speed, and consequently its voltage, falls below a certain value. There are also provided automatic voltage regulators for the various circuits so that the lamps and the storage battery will receive the proper potential while an ampere-hour meter indicates directly the state of charge in the battery in ampere-hours.



The Simple, Yet Exact Automatic Switchboard which Cares for the Dynamo and Storage Battery Currents, Besides Regulating the Voltage Supplied to the Car Lamps. It Even Indicates the Ampere Hours Left in the Battery.

COBWEBS TROUBLESOME ON ARGENTINE TELEGRAPH LINES.

Mr. J. W. Stubbs, superintending telegraph engineer, Buenos Aires and Pacific Railway, Argentina, says that telegraph and telephone wires in the Argentine Republic are at certain seasons of the year subject to a partial or almost entire interruption, owing to the prevalence of spiders' webs (known colloquially as Devil's Beard), which covers the wires for a distance of many miles, and which, as soon as the sun sets, become saturated with moisture, causing contacts between the various conductors.

The webs themselves are like gossamer threads, but are in such abundance that as much as eleven pounds in weight have been swept from a line of four wires over a distance of six and a quarter miles. When swept together the webs have the appearance of a kind of gray cotton waste, which will not flame up when lighted but smoulders for a considerable time.

The trouble is so serious that the Argentine government addrest a circular to the different telegraph administrations all over the world to ascertain if anything similar was experienced elsewhere, and, if so, the means taken to counteract it. The replies received showed that in no country outside South America was anything of a like nature met with.

WOMAN TAXI DRIVER OPERATES ELECTRIC.

Boston has one woman chauffeur, and only one. She drives a taxicab, an electric machine, and is making a success of her undertaking. The young woman is Miss Florence Mayo, and her stand is on Newberry Street, in the fashionable Back Bay district. Miss Mayo undertook the work partly on account of failing health. She conceived the idea of running a gasoline taxi, but found there were no facilities for learning to operate. Consequently, she turned to the electric machines. It took only a few hours to learn the mechanism. Recently Miss Mayo carried a patient who was very ill to the hospital, his physician not daring to risk a gasoline car.

RADIO MESSAGES PASS BETWEEN JAPAN AND U.S.

Trans-Pacific wireless service between the United States and Japan was established on November fifteenth by the Marconi Wireless Telegraph Company. The inauguration of the service was marked by the exchange of messages between the two countries.

President Wilson sent this greeting to the Emperor of Japan:

"The Government and people of the United States of America send greetings to your Imperial Majesty and to the people of Japan, and rejoice in this triumph of science which enables the voice of America from the Far West to cross the silent spaces of the world and speak to Japan in the Far East, hailing the dawn of a new day.

"May this wonderful event confirm the unbroken friendship of our two nations and give assurance of a never-ending interchange of messages of good will. May the day soon come when the voice of peace, carried by these silent messengers, shall go into all the world and its words to the end of the world."

The message was sent from the station of the Marconi Company at Bolinas, Cal., to its receiving station at Kahuku, Hawaii, and instantaneously retransmitted by automatic relay to Funabashi, Japan, station of the Japanese Government.

Emperor Yoshihito of Japan replied by wireless to the message of President Wilson as follows:—

"It affords me much pleasure that the first use of the installation of wireless telegraphy between Japan and the United States has been to transmit your cordial message. In return I send this expression of my thanks for the good wishes exhibited toward me and my people, and of the hearty desire entertained thruout Japan for the continued prosperity and welfare of the United States."

Wireless communication between the United States and Hawaii was put in operation September 24, 1914.

The establishment of wireless communication with Japan creates a new and important chapter in the wonderful scientific records of the Nineteenth and Twentieth Centuries. It will largely increase good business and friendly feeling between the two countries. Now that the service has been extended to Japan, connection will be made with the Japanese Imperial Telegraph system to all points in the Orient.

For the present the service will be confined to San Francisco, Hawaii and Japan. There will be two classes of service between San Francisco and Japan, a full rate or expedited service at 80 cents per word, a reduction of 41 cents per word from the existing cable rates, and a deferred half-rate service at 40 cents per word, the lowest cable rate at present being $1.21 per word.

In the first hour in which the service was put in operation fifty-two messages of congratulation were received and transmitted. Among these was an exchange of greetings between the Japanese Ambassador to this country and the American Ambassador to Japan. Guglielmo Marconi and Godfrey Isaacs sent their congratulations to Jiro Tanaka, Director of Posts and Telegraphs of Japan.

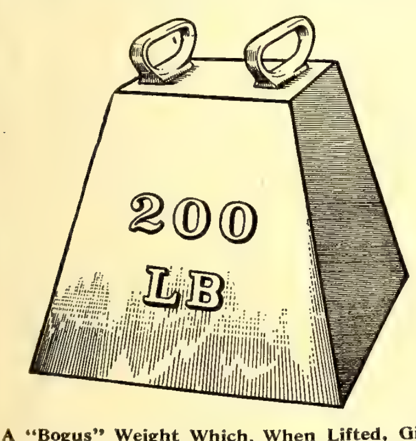
MYSTERIOUS ELECTRIC WEIGHT "HEFTY" BUT NOT HEAVY.

The day of the famous or rather infamous *goat*, which all new lodge and fraternity candidates are supposed to ride before they are accepted as full-fledged members, is being daily electrified in several ways.

Some time ago there was an electric "initiation" chair described in the columns of THE ELECTRICAL EXPERIMENTER, arranged with a small shocking coil, battery and sensitive spring contact in the seat, so that when the newly elected candidate sat on it he would receive the surprise of his life, and not in the form of a glad hand, either!

The present illustration shows a newly conceived, electrified weight devised by Mr. John J. Odenwald, for use in initiating new members of secret fraternities and similar organizations.

Within a bogus weight, marked conspicuously 200 pounds, as shown, but with an actual weight of less than 40 pounds, there is placed the necessary electric shocking paraphernalia, comprising a small induction or shocking coil, a couple of dry cells and an automatic switch which is closed as soon as the victim, in his effort to lift the weight, exerts an upward pressure on the handles at the top. The amusement caused by the consternation of the person trying to lift the weight may be easily imagined



A "Bogus" Weight Which, When Lifted, Gives the Would-be Samson the Surprise of His Life in the Form of an Electric Shock.

and also the gullibility with which he will seize the opportunity of showing his marvelous physique. It goes without saying that he won't hold on to it for many seconds.

IN THE FEBRUARY "E. E."

Nikola Tesla, His Life and Inventions—Some things you don't know about this great genius. Wonderfully illustrated with a supplement of Mr. Tesla suitable for framing. By Samuel Cohen.

Electric Power from Ocean Waves—A scheme to utilize in a new way the inexhaustible energy inherent in the ever-rolling waves of the sea. By H. Winfield Secor.

Baron Münchhausen in a New Martian Adventure. By Hugo Gernsback.

Experimental Physics—Start of a new and intensely interesting series. By John J. Furia, A.B., M.A., F.K.S.

Testing Ultra-high Voltages with Spark Gaps—With complete details and tables.

Bakelite—The New Insulation. How it is made and its properties.

Construction of a Practical 6 Volt, 25 Ampere-hour Storage Battery. By B. Francis Dashiell, M.E.

Celluloid Jars for Storage Batteries and How to Make Them Cheaply.

A New Circuit for Undamped Wave Signal Reception, Including Loose Coupler Details. By Dr. G. M. Christine.

The How and Why of Radio Apparatus. Part 3—High Tension Condensers, How to Design and Build Them.

The Design of Large Radio Receiving Transformers—A Mathematical treatment of this all-important subject with curves and tables worked out, for wave lengths up to 10,000 meters and above. By Charles S. Ballantine.

The Kilbourne and Clark Wireless System—Something new.

ELECTRIC LAMP HELMET FOR ENGLISH POLICE.

The accompanying illustration shows one of the latest European novelties in the form of an electric flash lamp bulb attached to the spike of the helmet, as worn by the policemen of Birmingham, England.

English Policemen Now Carry a Miniature Electric Signaling Lamp on Their Helmets. Highly Effective During "Zep" Raids When Streets Are Darkened.

The light is supplied with current from a small battery carried on the belt and the communicating wire between the lamp and battery is plainly visible in the photograph. The lamp can be switched on and off rapidly for signaling purposes, particularly when streets are pitchblack, as during a Zeppelin raid, and would also appear to provide a very satisfactory method of communicating with other policemen in the event of riots, street fights, etc.

It has perhaps been noticed that in many a street brawl the officer of the law does not always have the upper hand, by any means, and it frequently happens that the policeman finds it extremely difficult, if not impossible, to rap on the pavement with his trusty club or to blow his whistle the required three blasts.

It would be readily possible to arrange such a flash lamp as here shown so that its battery circuit could be closed either by pressing a push button carried on the belt, in the gauntlets, or by the pressure of the foot in a certain way.

Some months ago we chronicled in these columns the merits of a new-fangled electric foot warmer as used by the Pittsburgh, Pa., police traffic squad. We wonder if there is not some electric genius who would be so considerate as to invent an electric kit, whereby our friend the policeman can push a button and have his hot clam bouillon and coffee at any time.

The life of a Twentieth Century policeman will yet become a highly desirable and irresistible vocation thru the medium of that genie of all genii—Electricity.

THE ELECTROPHONE PRODUCES MUSIC ELECTRICALLY.

Herewith we present the *Electrophone*, an electrically actuated musical instrument. The action is absolutely unique and a departure from any used in similar instruments now being manufactured, the inventor claims. One of the principal advantages of the new action employed is that there is practically no chance for it to get out of repair, and no cumbersome dry cells

The "Electrophone"—A New Electrically Played, Tubular Musical Instrument, Which Is Here Seen Mounted on a Piano. It Employs a Separate Keyboard, Seen at the Right.

or storage batteries are required. It works equally as well on direct or alternating current circuits. It works nicely on A.C. thru a small transformer. The illustration shows it placed on top of a piano, but this is done merely as a convenience. It has no connection with the piano. The Electrophone runs three octaves chromatic and is played by means of a small keyboard attached to the piano and can be played singly or with piano accompaniment. The tone can best be described as "harp like" 'tho it is not a stringed instrument. The Electrophone presents a handsome appearance and provides a new piece of music for professional and amateur or home music circles alike. It was invented by Mr. Ingvald Brown, a genius from Idaho.

A REMARKABLE HIGH TENSION INSULATOR.

By Frank C. Perkins.

The accompanying illustration shows a remarkable high tension insulator developed at Detroit, Mich., which several power companies have tested under oil and punctured some at 300,000 volts; 200,000 volts being an average value for puncture strength of these discs. These insulators have stood high frequency flashover tests for one hour. Instead of the usual rigid, malleable iron caps and solid pins, two spider-shaped caps are used, whose eight legs fasten at a depth of one inch into the upper and lower sides of the insulator. The flexibility of the legs prevents expansion and contraction strains on the porcelain, absorbs shocks and distributes the tensile strain uniformly.

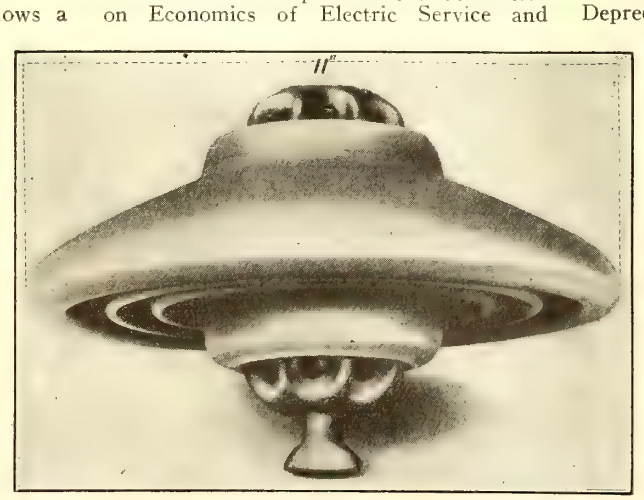
No cement is used on this insulator, the spider legs being anchored into recest holes in the porcelain by means of a special alloy similar to that used in die casting. This alloy, as applied, does not shrink away from the porcelain and has a very low coefficient of expansion. The insulator will stand plunging from boiling to ice water without harm. This test was made by several power companies.

This construction gives the disc an ultimate breaking strength of 8,000 to 10,000 lbs. The electrical properties have been proven not to be affected in the least up to the full breaking strain. In this disc the electrical and mechanical strains occur at entirely different parts of the porcelain.

The diameter of the unit is 11" and the distance between units assembled 6½". The dry flashover tests of one unit at normal frequency showed 97,000 volts and with two in series the pressure was 184,000 volts while three in series withstood 253,000 volts. In the wet flashover test (precipitation 1" in 5 min.) 50,000 volts was used and with two in series 92,000 volts, while four in series withstood 185,000 volts and with five in series the pressure was 220,000 volts. It is stated that the high frequency oscillator test gave a first arc-over value with one disc of 120,000 volts and with five units in series 500,000 volts.

In testing insulators each unit is mechanically tested to a strain of five or six thousand pounds, then it will be tested electrically to flashover for ten minutes on a 60 cycle transformer of the General Electric Co., type with a high frequency oscillator for 250,000 volts. As soon as this is finished the disc is tested on high frequency as it is better to find the weaknesses before putting the insulators on the line than afterward. This insulator when it is once put up, will not have to be taken down due to any di-electric or mechanical weakness in the insulator.

It is held that the disc has proven by tests, both on normal and high frequency to avoid corona up to 90,000 and even 110,000 volts, whereas a disc ¾" thick is under corona at 30,000 volts. Some experimenters claim to have observed it at much lower voltages. This disc will insulate permanently, because of its safe dielectric stresses and the perfectly balanced field is also very important in securing the full value of the insulating material and enabling the insulator to resist high frequency and other line conditions caused by lightning and switching.



A New Design of Insulator Which Required 300,000 Volts to Puncture It.

NOVEMBER MEETING OF AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

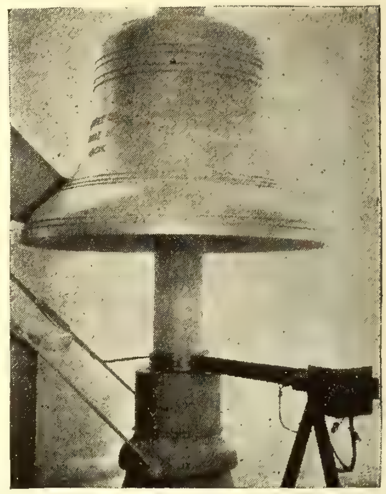
The 326th meeting of the American Institute of Electrical Engineers was held in the Engineering Societies Building, New York City, on November 10th.

The meeting was well attended and was held under the auspices of the Committee on Economics of Electric Service and dwelt principally on the subject of Inventories and Appraisals. Three papers were presented bearing the following titles: "The Effect of Recent Decisions on the Work of Inventory and Appraisal," by Dr. Philander Betts; "Continuous Inventories; Their Preparation and Value," by Harry E. Carver, A.B., M.E.; and "Growth and Depreciation," by Julian Loebenstein, E.E.

The papers were well received and were of particular moment at this time when the engineering societies and specially appointed Governmental boards are so busily involved in the general appraisal and inventorying of the country's resources in order to put the United States on thoro preparedness basis.

HOW THEY HEARD THE BELLS OF NEW YORK IN 'FRISCO.

You have all heard or heard of the various sounds that have been floating thousands of miles across the transcontinental telephone line for the past year—bell-ringing, surf noises, "Hello 'Frisco" quartets, and what not. Here is one of the best known entertainers—a bell on the lofty Metropolitan Building tower at Madison Square, New York. It has rung for thou-



How a Sensitive Microphone was Attached to a Large Bell in New York so That Its Sound Could Be Heard Telephonically in 'Frisco.

sands of people listening in on the transcontinental line. A sensitive microphone can be seen mounted to one side of the base. This is connected up with the local telephone exchange and as the bell is rung the sound acts on the microphone, causing variations in its electrical resistance and consequent fluctuations in the line current. These electrical pulsations fly along the circuit with the velocity of light or 186,000 miles per second, and finally they arrive at the receiving instrument where a transformation of electrical into mechanical energy occurs and we hear once more the toll of the bell, possibly 4,000 miles away.

NEW WIRELESS STATION ON AFRICAN COAST.

Military engineers are erecting a wireless station on Cape Juby, on the African coast, and expected to have it in operation before October first. In cases of need at sea the service will be available for ships in distress. As the big installation on Teneriffe Island is less than 100 miles from the Cape Juby plant, communication with the Canary Islands will be possible and, thru them, with the Spanish mainland. A regular steamship service to Cape Juby, with sailings from Santa Cruz de Teneriffe on the 28th of each month, has been announced.

WASHING DISHES BY ELECTRICITY.

The advent of the electro-mechanica dishwasher marks one more important ste toward the passing of household drudgery The process of washing dishes by the modern electric dishwasher here shown, is a simple as by hand.

You know that when you wish to sterilz a bottle you scald it, and when you desir to kill the germs in drinking water, yo boil it. This dishwasher is sanitary because in using the machine the dishes ar washt and dried in exactly the same manner, by scalding them with boiling water therefore they are perfectly clean and don in a sanitary manner. This is a decide improvement over the old way of dish washing by hand. The dish rag and dis towel that washes and wipes the first dis generally washes and wipes the last, an unless the most scrupulous care is take the result is neither wholesome nor app tizing, and germs of disease are often th result. From a sanitary standpoint, t dish rag and dish pan have been severe criticized, and they are doomed to eventu elimination.

The distinguishing points of this ele tric dishwasher are its simplicity in co struction, ease of operation and its thor satisfactory results. It rinses, sterilizes a dries the dishes and eliminates breaka and is so designed in its method of dra

SIGNAL LAMP INDICATES IRO ING CURRENT "ON" OR "OFF."

One of the common curses of humanity is its well-known faculty for forgetting. The best trained memory will play treacherous tricks. The person who forgets what should or should not be done subjects himself to the proper penalty and pays it.

A Typic
Suitab

Often the user of an electrically heated device is suddenly called away and forgets to remember that current is on—so the device is left to its own destruction—or to do something worse.

Wherefore an enterprising genius has now favored us with a gentle reminder in the guise of the "Signalite" gap, designed for use with electrically heated devices of 10 amperes capacity or less to indicate when current is on or off. It is a combination of attachment plug and miniature lan socket, constructed as a unit.

A miniature lamp is enclosed in an ele trically welded guard and gives a warni light as long as current is on. The cu rent consumption is so small that it do not lessen the efficiency of the device th is operated.

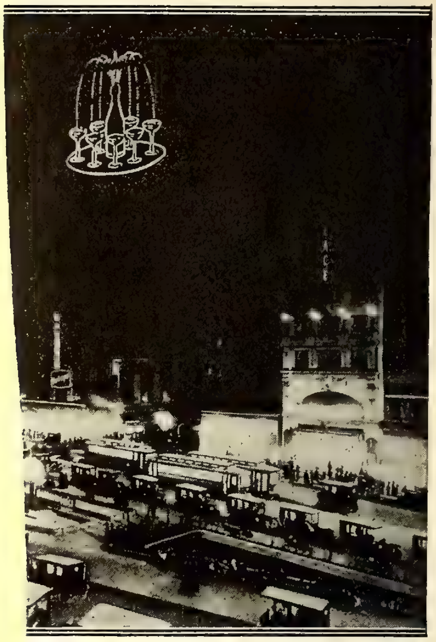
The device thus serv as a ready, steady mem ory jogger that caution against forgetfulnes when operating electri flat irons, soldering iron toasters, chafing dishe etc.

The light burns whil the device heats. It at tracts the eye, prods th memory and reminds th user not to leave the de vice to become over heated, thereby destroyin the element or causin fire.

The General Electric Company has 1 830,000 square feet of floor space availa for the manufacture of electrical machine and devices.

'ATCH THE GLASSES FILL UP IN THIS ELECTRIC SIGN.

The accompanying photograph illustrates ıe of the latest electric signs on Broad-ay, New York City, which has been much lmired. This gigantic and spectacular splay is located at Broadway and Forty-venth Street, where thousands of people ·e bound to see it nightly.



tric Signs—The Bottle Effervesces as Shown sses. It Extinguishes for a Moment, When the Action Is Repeated.

'he illuminated bottle, representing a l-known drink, effervesces in the man- here shown, the various scintillating :ams filling up the goblets. The glasses y be seen to fill up very realistically l as the "liquid" (composed of electric bs) rises near the top of the glasses the ole display is extinguished, only to be ›eated in a few seconds.

The bottle in this sign stands 29 feet ;h, while the glasses measure 13½ feet, : tray being 43 feet long. The complete n is lighted by 2,400 tungsten lamps ich are controlled by special, motor-ven circuit-breakers.

'hoto courtesy O. J. Gude Company.

1 volt. The change in conductivity oc-ioned by the light from a 40-watt .gsten lamp at 20 cm. is about 15 cent. The area exposed to radiation is ›ut 12 mm². If this cell be connected to !-volt cell and a galvanometer (forming :t of a simple potentiometer) a sensitive /ice for detecting radiant energy is pro-ced. Exposing the cell to daylight in a ›derately lighted room throws the galva-meter spot of light violently off the scale. onochromatic radiations which are quite ɔ feeble to affect a sensitive radio-mi-ɔmeter, bring about large deflections when owed to fall on the copper-oxid cell. If ɛ cell be connected to a telephone receiver ıd battery and if an intermittent light am of definite frequency be allowed to ll on the cell, a clear, musical note is ard.

The preceding discussion is to be looked on as being of a preliminary nature. A stematic search for light-sensibility is be-; undertaken and a complete account of : work will appear later.

'he largest coal mine in the world at 'comis, Ill., where one thousand tons of l are taken out every hour, is entirely rated by electricity.

WASHING DISHES BY ELECTRICITY.

The [illegible] of the electro-mechanical dishwasher marks one more important step toward the passing of household drudgery. The process of washing dishes by the modern electric dishwasher [illegible], is as simple as by hand.

You know that when you wish to sterilize a bottle you scald it, and when you desire to kill the germs in drinking water, you boil it. This dishwasher is operated [illegible] in using the machine the dishes are washed and dried in [illegible] manner by washing them with boiling water, therefore they are perfectly clean and done in a sanitary manner. This is a decided improvement over the old way of dishwashing by hand. The dish rag and dish towel that washes and wipes the first dish, generally washes and wipes the last, and unless the most scrupulous care is taken, the result is neither wholesome nor appetizing, and germs of disease are often the result. From a sanitary standpoint, the dish rag and dish pan have been severely criticized, and they are doomed to eventual elimination.

The distinguishing points of this electric dishwasher are its simplicity in construction, ease of operation and its thoroly satisfactory results. It rinses, sterilizes and dries the dishes and eliminates breakage and is so designed in its method of drain- [illegible] that it automatically cleanses itself and [illegible] of any accumulation of grease or food refuse.

[illegible] of industry, [illegible] style of dishes, [illegible] the necessary knives, forks and spoons can be washt in one minute.

The [illegible] is cylindrical in shape and is made of heavy metal, the interior being so treated as to make it rustproof. The interior has a free cleansing surface, care being given in designing it to eliminate all pockets or projections liable to collect grease or food particles. The exterior has finish in white enamel. The [illegible] upon which the [illegible] rest.

The [illegible] have a connection to the water and gas mains for the purpose of giving a plentiful supply of water and gas, the latter being necessary to heat the water. The revolving grid and "dashers" are operated by two small electric motors. Attachment plugs and cables are provided in both types of machines for connections to the ordinary electric service mains.

A Typical Installation of a Light S[illegible] or Family Size Electric Dishwasher. Suitable for Placing in a Corner Where Economy of Space is a Factor.

SIGNAL LAMP INDICATES IRONING CURRENT "ON" OR "OFF."

One of the common curses of humanity is its well-known faculty for forgetting. The best trained memory will play treacherous tricks. The person who forgets what should or should not be done subjects himself to the proper penalty and pays it.

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A miniature lamp is enclosed in an electrically welded guard and gives a warning light as long as current is on. The current consumption is so small that it does not lessen the efficiency of the device that is operated.

The device thus serves as a ready, steady memory jogger that cautions against forgetfulness when operating electric flat irons, soldering irons, toasters, chafing dishes, etc.

The light burns while the device heats. It attracts the eye, prods the memory and reminds the user not to leave the device to become overheated, thereby destroying the element or causing fire.

The General Electric Company has 14,830,000 square feet of floor space available for the manufacture of electrical machinery and devices.

AN ELECTRIC HEAT BLOWER OF MANY USES.

[illegible]

A New Household Convenience in the Form of an Electric Heat Blower. It Can Be Used for a Variety of Purposes.

electric blower and heater here illustrated. When little Willie takes a bath, make him feel good—evaporate the moisture from his body with a draft of heated air; a hundred and one other applications abound to which this sturdy little heat blower lends itself admirably. Wherever a steady blast of heated air at any desired temperature is wanted, this device will prove exceptionally welcome.

The blower element comprises a specially designed, multiple vane rotary drum which is mounted on the shaft of an electric motor of suitable size. The air passes over an electric heater grid placed in the discharge channel so that the outgoing stream of air is [illegible] warmed. The complete unit is fitted with a handle for carrying about, and it may be connected with any convenient lamp socket.

HOW CIVILIAN ENGINEERS MAY AID THEIR COUNTRY.

On July first the new law providing for the National Reserve Corps of Engineers became effective. A general outline of this legislation was published in the March, 1916, Proceedings of the American Institute of Electrical Engineers, as reported by the Joint Committee of five national engineering societies which had been appointed to assist the War Department in the formation of the National Engineer Reserve. The War Department has recently completed details of requirements and qualifications for commissions in the officers' reserve corps of the army.

Commissions will be issued for the rank of Major, Captain, First and Second Lieutenant. The commissions will be for five years renewable, however, with the approval of the Secretary of War and after a physical examination. Holders of commissions are subject in time of peace to duty in instruction camps and elsewhere of two weeks each year, or longer with the officers' consent, and it is expected that a reasonable latitude in the choice of time for this service will be allowed. They are subject to order to duty by the President whenever war is [illegible] a rank not below that held in the Reserve Corps of Engineers.

Reserve officers from the following civilian occupations will be required for the special services of the Corps of Engineers:

Bridge engineers.

Construction engineers (earth and concrete).

Constructing engineers (wharves, piers, and buildings).

Electrical engineers (for small plants and power lines).

Highway engineers,

Mining engineers (skilled in tunneling and use of explosives),

Railroad engineers (construction and maintenance),

Railroad operating officials,

Sanitary engineers,

Topographical engineers,

There is no maximum age limit for the Engineer Officers' Reserve Corps.

Engineers desiring to avail themselves of the opportunity thus presented for honorable service in the Army of the United States should at once send to the Chief of Engineers, War Department, Washington, D.C., for application blanks.

In smelting and preparing various high grade metals the electric furnace has many advantages, commanding as it does the very highest temperatures. The electric furnace is used for making the very highest quality of steel and for many special alloys. Not only does it give the very highest temperatures but with this type of furnace these very high heats may be readily controlled. Furthermore, with electricity there is no danger of contaminating the charge.

COLOR EFFECTS OF POSITIVE AND NEGATIVE RAYS IN GASES.

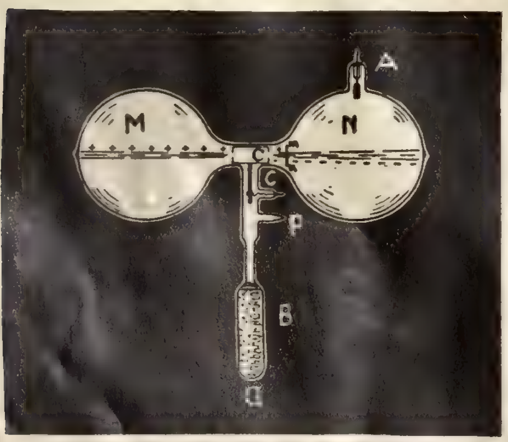
A new vacuum tube for demonstrating the color effect of anodic and cathodic rays in residual air, hydrogen, helium and other gases is described by Charles T. Knipp in *Science*, who, in conjunction with Dr. Jakob Kunz, designed the tube. It consists of a dumbbell shaped vessel as shown in the illustration and is formed of two 2 liter Florence flasks, M and N. The hollow, cylindrical cathode C is mounted in the neck, while A is placed in one of the bulbs. The cathode terminal C, the nipple P for exhausting and the charcoal bulb B are all attached to one vertical tube as shown.

After the tube is constructed and the charcoal bulb B is attached, the exhaust nipple is put in communication with a pump and also to a source of the certain gas to be used. The exhaustion is continued until sparking shows a tendency of becoming *hard*. As this stage is approacht, the cathodic rays will appear as a compact beam in the bulb N, while a beam of positive rays will traverse the bulb M. Now a small quantity of gas, say helium, is admitted. The chances are that too much gas will enter the discharge tube and thus destroy the definition of the two beams. To restore it, pumping should be continued and at the same time the bulb B should be carefully submerged in liquid air. The cooled charcoal will absorb the traces of air leaving the tube M, N, relatively richer and richer in helium—since helium, an inert gas, is but slightly absorbed by the cooled charcoal.

The cathodic beam as well as the positive ray beam in M, will each increase in brightness and definition, reaching a maximum, after which, as the process continues, they will begin to fade. At the stage when the beams are judged brightest the exhaust nipple P is sealed off from the pump. Removing the liquid air, the charcoal gives up its absorbed gas and the beams weaken and become diffused.

The most interesting phenomenon is the *color* of the two beams. The cathodic beam in helium is a greenish gray color, while the positive ray beam in the same gas is a beautiful red. There is no mistaking the colors. Indeed, the red due to the positive ions is so persistent that it appears at the very origin of these rays, at the edge of the Crookes *dark space* in front of the cathode (shown by the dotted lines m—n, in the illustration).

An interesting test to show that the beam



Interesting Scheme for Demonstrating the Color Effects of Positive and Negative Rays in Various Gases, Utilizing a Dumb-Bell Shaped Glass Vessel as Shown.

in N is composed of electrons, and that in M of positively charged ions, is to deflect them in turn by a strong electro-magnet. The cathode beam is readily deflected, while the positive ray beam is but slightly deflected and that in the opposite sense. This is in full agreement with the theory of the magnetic deflection of moving positive and negative charges.

The chief difficulties encountered in experiments of this kind are that extreme care must be taken in exhausting the tube of air and proper precaution must be exercised in admitting the correct amount of gas into the evacuated chamber.

THE LIGHT SENSIBILITY OF COPPER-OXID.

The fact that selenium changes its electrical conductivity under the influence of light was discovered by May, in 1873. Since that time the property of light-sensibility has been lookt for in many substances and it has been found that sulphur, shellac, paraffin, anthracene and several other substances possess this property to a slight extent, says A. H. Pfund in *Science*. The most noteworthy addition to the list was made by Jaeger, who discovered the light-sensibility of stibnite (native Sb_2S_3) in 1907. Since a careful study of the behavior of these substances is bound, ultimately, to shed light on the mechanism of metallic conduction, it seemed worth while to continue the search for other substances which show marked light-sensitiveness. Recently the writer found that copper oxid (Cu_2O, presumably) shows the effect quite unmistakably.

Without going into details here as to the mode of production of copper-oxid cells or bridges, it may be stated that copper-oxid has a much lower specific resistance than either selenium or stibnite and is much the more transparent toward red light (layers having a thickness of more than 1 mm. are still slightly translucent). The fundamental facts which have been establisht for this new light-sensitive substance are:

1. The conduction is electronic and not electrolytic.
2. The increase in conductivity, occasioned by light, is distinctly different from that produced by a heating effect.
3. The conductivity increases with the applied voltage, *i.e.*, Ohm's law is not obeyed (voltage effect).
4. The region of increased conductivity spreads slightly to portions of the material not illuminated (transmitted effect).
5. The region of highest sensibility not illuminated (transmitted effect).
6. The region of highest sensibility lies in the ultra-violet near 2800 A. U.?
7. Cooling in liquid air increases the percentage change in conductivity and displaces the sensibility maximum in the red toward shorter wave-lengths.
8. The relation between the radiant energy absorbed (E) and the resultant change in conductivity (C) is very approximately of the form $C=KE^p$ where K is a constant and lies near 0.5

While the percentage change in conductivity upon illumination is much less than that of selenium and stibnite, the comparatively high conductivity of copper-oxid makes the absolute increase quite large. The best cell which the writer has thus far constructed has a resistance of 15,200 ohms at 17° C. for 1 volt. The change in conductivity occasioned by the light from a 40-watt tungsten lamp at 20 cm. is about 15 per cent. The area exposed to radiation is about 12 mm^2. If this cell be connected to a 2-volt cell and a galvanometer (forming part of a simple potentiometer) a sensitive device for detecting radiant energy is produced. Exposing the cell to daylight in a moderately lighted room throws the galvanometer spot of light violently off the scale. Monochromatic radiations which are quite too feeble to affect a sensitive radio-micrometer, bring about large deflections when allowed to fall on the copper-oxid cell. If the cell be connected to a telephone receiver and battery and if an intermittent light beam of definite frequency be allowed to fall on the cell, a clear, musical note is heard.

The preceding discussion is to be looked upon as being of a preliminary nature. A systematic search for light-sensibility is being undertaken and a complete account of the work will appear later.

WATCH THE GLASSES FILL UP IN THIS ELECTRIC SIGN.

The accompanying photograph illustrates one of the latest electric signs on Broadway, New York City, which has been much admired. This gigantic and spectacular display is located at Broadway and Forty-seventh Street, where thousands of people are bound to see it nightly.

A Novelty in Electric Signs—The Bottle Effervesces as Shown and Fills the Glasses. It Extinguishes for a Moment, When the Action Is Repeated.

The illuminated bottle, representing a well-known drink, effervesces in the manner here shown, the various scintillating streams filling up the goblets. The glasses may be seen to fill up very realistically and as the "liquid" (composed of electric bulbs) rises near the top of the glasses the whole display is extinguished, only to be repeated in a few seconds.

The bottle in this sign stands 29 feet high, while the glasses measure 13½ feet, the tray being 43 feet long. The complete sign is lighted by 2,400 tungsten lamps which are controlled by special, motor-driven circuit-breakers.

Photo courtesy O. J. Gude Company.

The largest coal mine in the world at Nokomis, Ill., where one thousand tons of coal are taken out every hour, is entirely operated by electricity.

Reginald A. Fessenden—This Month's Supplement

REGINALD AUBREY FESSENDEN, the subject of this month's supplement, is thought by many as being the greatest living Wireless Inventor today.

To Dr. Fessenden belongs the great honor of having invented the first practical Wireless Telephone as well as scores of important apparatus used today in every modern radio station.

Professor Fessenden, was born in Bolton, Quebec, Canada, on October 6, 1866, the son of the Rev. E. G. Fessenden. He was educated at the De Veaux Military School, Suspension Bridge, N.Y., and at Trinity College School, Port Hope, Ontario, Canada, and at an early date manifested a particular liking for mathematical and scientific subjects. This eventually led into electrical and wireless channels and Professor Fessenden has since been busily engaged in extensive research work along these and allied lines. He was chemist-in-chief in Thomas Edison's laboratory from 1887 to 1890 and served in the following two years as electrical expert with the Westinghouse Company of Newark, N.J. He was elected professor of electrical engineering at Purdue University, 1892-1893 and served in a similar capacity at the Western University of Pennsylvania in 1893. He holds patents on many inventions in chemical engineering and has written numerous scientific papers. Dr. Fessenden married Helen May Trott, of Bermuda, in 1889.

He is the inventor and patentee of a number of practical and extremely original wireless devices, many of which are being used today with marked success.

Professor Fessenden was officially selected by the U. S. Government under the auspices of the Weather Bureau, in the year 1900, to take up a systematic investigation of the problems of radio-telegraphy. Early in 1901 the Weather Bureau officially installed him at Wier's Point, Roanoke Island, North Carolina, and from this and other points along the Atlantic seaboard, he carried out successfully a number of very important radio tests.

His researches proved fruitful and on August 12, 1902, there were issued to Professor Fessenden, 13 patents on miscellaneous methods, devices, and systems for transmitting intelligence without wires. These patents covered improvements in construction of antennae; method of localizing signals; special selective system; means of amplifying received signals; wave shute or wave gate for directive wireless telegraphy; method of localizing, generating and receiving two distinct sets of waves of different periodicity; wireless telephone; compress air spark gap; a method of recording received radio signals on photographic paper, etc., etc.

He is known best in radio circles for his work in developing and perfecting his detector of wireless signals known as a *Barretter,* also the electrolytic detector and radiophonic apparatus. Several important inventions in the radio art which are always linked with the name of Fessenden are the special high frequency alternating current generators, developing frequencies in the region of 200,000 cycles per second, for the purpose of transmitting speech *via radio;* the synchronous rotary spark gap mounted on the same shaft with the motor-generator, now common in all wireless installations, especially on ships, the Heterodyne method of receiving and amplifying the incoming wireless impulses, by superimposing on the receiving circuit a current of slightly different frequency than that of the incoming wave; special designs of heavy current microphones for modulating the antenna current by means of the voice in wireless telephone stations; interference preventer for effectively tuning out different unwonted stations and excessive *static* (atmospheric) currents.

One of Professor Fessenden's extremely practical and timely inventions is an electrical system of submarine signaling which is applicable to submarines, warships and steamships, or between two points of land. The invention utilizes the principle of conduction of sound thru water. He has attained, in his experiments in this direction carried out in Boston Harbor and other points, both telegraphic and telephonic communication over distances of 8 to 20 miles and more, by setting up suitable and sufficiently powerful vibrations under the water. This is usually accomplisht by employing a powerful vibrator or oscillator secured to the metallic hull of the ship. These vibrations are thus transmitted thru the water at relatively high efficiency and are intercepted at any desired receiving point within range by ultra-sensitive microphones, similar to those used in telephony, which are mounted within a steel chamber filled with water and bolted fast to the hull of the receiving ship.

In the realm of radio-telephony Professor Fessenden is given credit for being one of the pioneers and early investigators of the gigantic problems here involved, who really did accomplish. Undoubtedly one of the first cases on record where speech was propagated several hundred miles thru space by Hertzian waves was that when Fessenden carried out his successful tests between Brant Rock, Mass., and Virginia.

WITH THE FEBRUARY ISSUE

we will present another

SUPPLEMENT

of a famous electrical inventor. This is the fourth of a series promised to our readers.

These supplements are printed on fine art paper, ready for framing. They are invaluable to adorn your den, your wireless station, or your laboratory.

Order your copy now, to make sure you will get it.

The electric ferryboat crossing the Rhine between Godesberg and Niederdollendorf accommodates 645 passengers, besides vehicles, and is propelled by two screws, each coupled directly with a thirty horse-power series wound motor, making 300 revolutions per minute. The storage battery of 160 cells has a voltage of about 300 and a capacity of 335 ampere hours. The actual crossing time is about four and one-half minutes, and after eight trips in each direction the battery is recharged at Godesberg. The same battery feeds three auxiliary motors on the boat, one used for pumping and the two others operating the landing bridge.

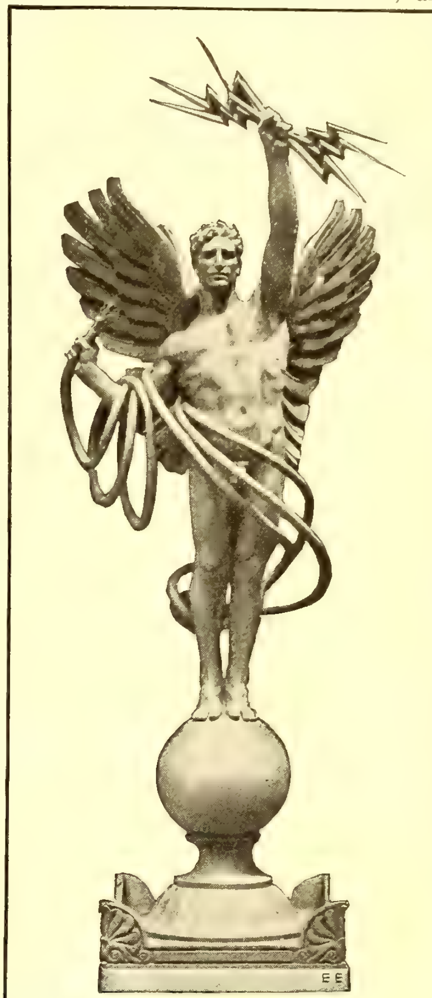
MAMMOTH "ELECTRICITY" STATUE.

Crowds gathered daily recently to gaze skyward at the great statue of "Electricity" which surmounts the Fulton Street tower of the new Telephone and Telegraph Building at 195 Broadway, New York, as it was raised to the roof of the building on October twenty-fourth and swung into place on the pinnacle of the tower.

The statue was modeled by Miss Evelyn Beatrice Longman of New York and was the winning design in a competition in which eight sculptors participated and of which the judges were Mr. Theo N. Vail, Mr. Daniel Chester French, the famous sculptor, and Mr. William Welles Bosworth, the architect of the building.

The statue is of bronze and has been covered with gold leaf, as the natural bronze becomes blackened when exposed to the weather, so that it would not be practicable for the purposes of this statue. The figure stands 24 feet in height, weighs 16 tons and reposes 434 feet above the street.

On the roof at 15 Dey Street as the statue was being raised to its position stood a little woman whose fine dark eyes were watching the consummation of nearly a year's work, work too, which had been extended over twice twelve months, and



Handsome Bronze Statue Representing "Electricity" which Surmounts the New Telephone and Telegraph Building in New York City.

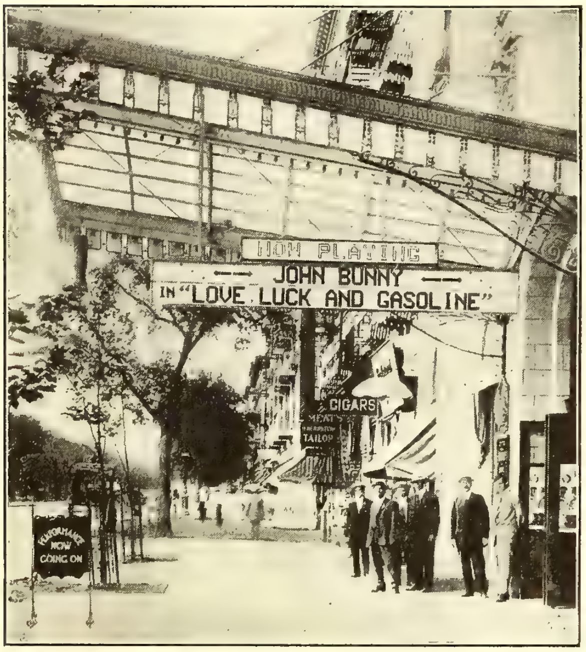
more. It was Miss Longman, the creator of the statue.

Very little about the inspiration which had prompted the statue, very little about the idea behind it, would Miss Longman say, more than that she had intended to express the power of electricity, its service to mankind, and the intangibility and mystery of its nature. And after all what need for a verbal explanation, when every line and contour of the statue itself is eloquent?

Of the technical side, the artist was more ready to speak, and the considerations of height and mass, of the effect of distance—for the great figure can be seen only from a distance—which had had determining influence upon the proportions of the statue, showed how much of science as well as of pure art, the artist must command.

NOVEL MAGNETIC CHANGEABLE SIGN.

We are all more or less acquainted with the little magnetic alphabet toy which was described in our December issue. This consists of a large number of curved iron strips supported in a suitable frame. By passing a small steel horse-shoe magnet over them, they are turned outward to produce a figure or letter. Practically any figure can be made with this device.



A Distinct Novelty in Theater Signs. Each Letter Is of the New, Magnetic, Interchangeable Type and by Means of a Steel, Horse-Shoe Magnet the Various Black Sections Can Be Pulled Forward so as to Form any Letter or Design Wanted.

The same principle has been recently utilized in a commercial sign. The only difference between the toy and the sign is that it employs a larger frame, which contains a considerable number of iron strips, so as to produce several letters. The accompanying photograph illustrates one of these magnetic signs as recently erected for a theater. The sign shown measures 20 ft. in length. When the time comes for the announcement of a new play, the operator who maintains the sign in proper order, simply passes a small horse-shoe magnet over the letters, thus setting the small black strips into proper position according to the letters desired. This unique sign, altho very simple in character, is a great time saver and produces a pleasing and satisfactory effect. *Photo Newellograph Co.*

RAILROADS COULD RUN ON "WASTE" OF COAL DUMPS.

Professor Charles Baskerville, head of the Department of Chemistry in the College of the City of New York, stated in a recent interview regarding the work of modern chemists:

"In any chemical problem there is no telling where the chemist will stop. Just now there are many chemists working on the problem of free gas. An immeasurable lot of power is wasted in the dumps of our coal mines. If this waste were reduced to gas by the retort process enough ammonia might be produced as a by-product to pay for the whole cost of the operation, making the gas free. The gas could then be used to generate electric power. Really, the Lackawanna Railroad ought to be running on the power it is now throwing away in these supposedly worthless dumps."

AN ORIGINAL AND EFFECTIVE MINE SIGNAL SYSTEM.

Recently a northern Michigan coal company equipt its shafts with a signaling system which is as effective as it is novel.

Confronted with a signaling problem in connection with their cage operations the mine officials cooperated with the Western Electric Company's engineers in the design of a special system as indicated above.

The system and its operation are simple, being essentially as follows: At each of the various mine levels loud-ringing extension bells are installed in pairs, each pair consisting of one six-inch and one eight-inch weatherproof type, loud-ringing gong. In connection with these bells, special switches are installed at each level. They consist of a telephone switch-book housed in a weatherproof cast iron casing. Attached to the switch-hook and hanging from the casing is a long leather strap similar to the well-known street car strap. Pulling this strap makes contact and rings the six-inch bells on every level and one in the engineer's room. When a man has loaded a car and wants it hoisted he pulls the leather strap a number of times—the number corresponding to a prearranged signal that corresponds to the operation desired. The bells ringing on each level in connection with the engineer's bell serves as a warning to the men on the various levels. The six-inch bells are on one circuit and the eight-inch bells on another—the latter being rung by the engineer when he is ready to hoist, or as a summons.

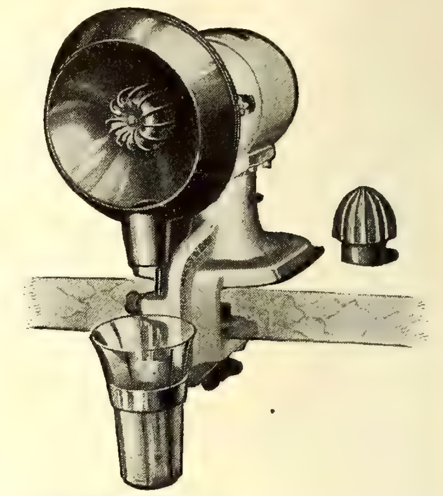
The wires of the signaling circuit are used for a telephone system, with a telephone set in the engineer's cabin and a set on every level. The system is simply a magneto party-line circuit and is used as a means of communication in connection with the signaling system between the various levels and the levels and the engineer.

The company has placed great reliance in its new signal system and has taken extreme precaution to keep it in uninterrupted operation. A supplementary circuit has been wired, so that if the ringing current in connection with the system should fail, warning bells will ring, summoning a repair man.

LEMON JUICE NOW BY ELECTRIC JUICE.

The electrically operated fruit-juice extractor illustrated has been perfected by a Philadelphia concern. This outfit is suitable for restaurants, soda fountains and all other places where it is necessary to extract the juice from large numbers of lemons or oranges quickly and efficiently.

It comprises a motor-driven hemisphere provided with ribs similar to the ordinary



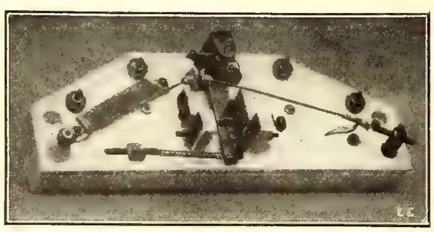
An Electrically Operated Fruit Juice Extractor. A Case of—When "Juice" Meets (Electric) "Juice."

hand-operated glass extractor. The lemon or orange is halved and held against this hemispherical part. The juice is caught in a deflector at the back and runs down thru a spout at the bottom.

A clamp is provided for quickly attaching the outfit to a table or counter and a ring is attached below the spout to support the glass. The outfit is equipt with 1/10 horsepower universal motor working on direct or alternating current lighting circuits. It will be found extremely useful in every household.

A DUPLEX THERMO ELECTRIC FLASHER.

The accompanying illustration shows one of the latest things in electric flashers



New Thermo Flasher that Blinks One Lamp On and the Other Off, Repeating the Operation at Any Desired Speed.

which performs a double function with the same thermo-element. It consists of flexible iron rod supported between three points, as seen in the illustration. This is indicated by the wide rod. A fine high resistance wire is wound over this, the connections of which are made at each end. One end of this wire is connected in series with an external resistance coil, which is seen at the left. This coil is used to prevent excessive current from flowing thru the thermostatic coil.

An insulator is placed in the center of this rod, connected to an arm of a long lever, which carries the control contacts. This lever is pivoted on a vertical upright, which is visible just behind the knob insulator of the V-shapt rod.

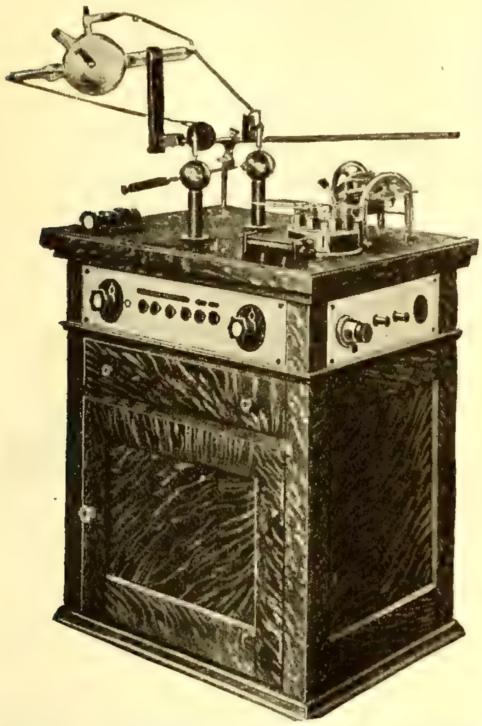
The thermostatic rod, the auxiliary resistance and the control contacts are mounted on a porcelain base. When current is past thru the device the thermostatic coil heats up, which expands the rod, and in doing so, it pulls the central arm, thus opening the first control circuit. The arm then closes the second circuit; at the same time no current is flowing thru the coil and thus it begins to cool, then falling back to its original position and closing itself. It will operate indefinitely providing, of course, the instrument is kept in proper adjustment. The tension of the thermostatic coil arm is variable by means of a knurled thumb-screw stationed on the right of the instrument.—*Photo Courtesy Betts & Betts.*

ELECTRIC LOCOMOTIVES FOR PANAMA CANAL HAULAGE.

Forty electric locomotives have been shipped from the Schenectady plant of the General Electric Co., to Panama, for the haulage of ships through the Canal locks.

AN ELECTRICAL CABINET OF WONDERS FOR PHYSICIANS.

We have all seen the magician put over his marvelous tricks and "mysteries," such as the box from which he proceeds to extract about everything imaginable—except



With This Complete Electric X-Ray and High Frequency Cabinet at Hand the Physician or Surgeon Is Prepared to Undertake the Treatment or Diagnosis of Most Any Case.

his salary. Well, the electric cabinet here illustrated and designed for our friend the doctor, is quite on par with those of Prof. Hermann, et seq. Among other things this physicians' electrical cabinet will supply a real X-Ray, high frequency or D'Arsonval current; also thermo-faradic, cautery, diagnostic lamps, air compressor—for aqueous and oily solutions—powder blower, hyperemia, cupping set, primary and secondary coil, etc.

The outfit includes 11 devices, and will accommodate attachments running to 14.

HAND SIGNAL LAMP FOR AUTO DRIVERS.

An electric hand lamp to make the extended hand of the driver an effective signal at night has been designed by a Pittsburgh electric concern. It is called the *Safety First* hand signal, and is worn the same as a wrist watch, only the elastic band which holds it in place fits around

This Illuminated "Safety First" Auto Signal Is Worn on the Hand by Means of an Elastic Band. You Can't Miss the Extended Hand at Night.

the hand instead of the wrist. It takes current from the socket in the dash-board through a very fine flexible silk cord. So little current is required that it can be burned all the time. Since every driver, instinctively, as a result of habit extends his hand to indicate his intention to stop, slow down or turn a corner, this lamp on the hand is a signal that nobody can fail to understand.

The miniature electric lamp is two candle power. It is enclosed in a polished nickel case, three inches in diameter and one inch thick. It is provided with a ruby bull's-eye one inch in diameter and throws a strong red light to signal to approaching cars the intention to turn. The bull's-eye is surrounded by the words *Safety First* cut out in white. Besides being effective as a signal to traffic, it enables the driver to get the immediate attention of the traffic officer. The device is very light in weight and its presence on the back of the hand is scarcely noticeable.

AN IMPROVED MAGNETIC RECTIFIER OF SIMPLE DESIGN.

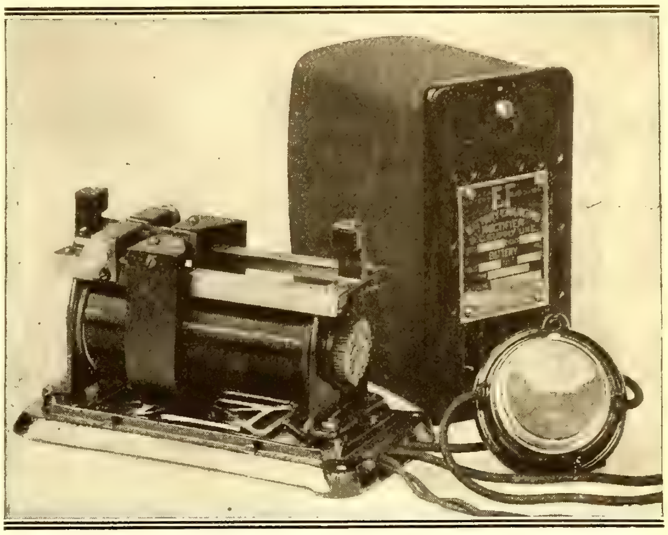
By Frank C. Perkins.

The accompanying illustration shows the design features of a unique magnetic rectifier recently developed at Cleveland, Ohio.

Among the many alternating current battery chargers in service may be mentioned this magnetic rectifier, which is a new and inexpensive device for charging small storage batteries of all types.

It is the constantly increasing use of storage batteries for a large variety of purposes that has created a demand for a charging device that does not require fixt conditions of installation, constant attention or expert knowledge, something that will charge storage batteries economically and conveniently.

In order to use the common alternating current house lighting or power circuit for charging a battery, some sort of a rectifying apparatus must be employed, which will cause all of the current to flow through the battery in the same direction. These conditions are met in the development of this new vibrating rectifier, as it will charge any battery of 8 volts or less, from a 100 to 125 volt, 60 cycle alternating current lamp socket, at an average current rate of from 6 to 8 amperes without any adjustment whatever.



New Type of Vibrating Magnetic Rectifier Intended for Charging Storage Batteries from A. C. Circuits at Home, at an Average Cost of Ten Cents.

It is claimed that the design here described, has overcome all inherent drawbacks in the existing types with their liquids, glass bulbs, sticking contact points, complicated mechanism, revolving armatures and current losses through resistance and a great step has been taken forward in the radical departure from these delicate and expensive apparatus.

There is a step-down transformer of special design used to reduce the line voltage down to the proper charging voltage. The core of the transformer is made up of many small soft iron wires, over which are wound the enameled copper wire primary and secondary windings. The low voltage charging current is passed through the rectifying element, consisting of a master spring armature, one end being rigidly attached to, and in magnetic relation to, the metallic end piece of the transformer core. The other end of the armature is free to vibrate between the fixt poles of a powerful permanent magnet. To the master spring are attached two opposing sub-springs, each of which carries a copper electrode which makes and breaks circuit with a carbon electrode. The light weight construction of the armature makes its action very positive and allows it to follow perfectly the alternations of the current, with its characteristic surges and variations in frequency.

It is pointed out that the powerful permanent magnet not only controls the vibration of the armature, but acts as a magnetic circuit breaker to open the charging circuit if for any reason the alternating current fails or is temporarily turned off and thereby prevents the battery from discharging through the rectifier. This rectifier is self-starting and upon resumption of the line current the charging circuit closes automatically and the charging is continued. It is entirely safe to put a battery on charge during the night.

The ampere charging rate also reduces as the voltage of the battery rises and the charge nears completion so that the battery will not be harmed by leaving it on over charge. Important advantages of the magnetic rectifier lie in the magnetic control of the armature of only one moving part and the non-sparking and permanent service of the carbon and copper electrodes where the rectification takes place. Carbon being infusible, will not roughen or stick and this, together with the feature of being able to adjust the carbons for any wear by simply turning a thumb-screw, makes them serviceable for long periods after which they can be renewed at very little cost. Other than this there is no maintenance expense or depreciation. The current cost per charge for the average battery is only from 3 to 15 cents.

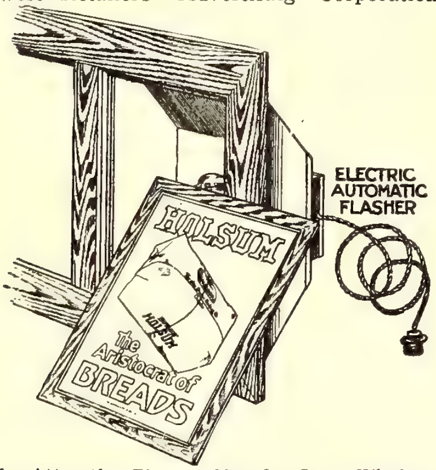
As to the efficiency, it is claimed that this rectifier utilizes the negative as well as the positive alternations of the current which causes a steady undirectional current to be generated which will charge all types of storage batteries and operate other direct current apparatus. It will run continuously at full load and complete a charge in exactly the same time as though the battery were being charged from a direct current source.

In order to operate the rectifier, it is only necessary to screw the extension plug into any convenient lamp socket and turn on the current. The positive (+) and negative (—) wires from the rectifier are then attached to their corresponding binding posts on the battery when the ammeter will indicate the proper charging current.

Recent Electrical Novelties

A NEW CHANGEABLE ELECTRIC SIGN FOR STORE WINDOWS.

Electricity is one of the few forces of nature that can be used to advertise itself as well as other goods. Now the Southwest Retailers' Advertising Corporation,



An Attractive Electric Sign for Store Windows. It is Equipt with a Tungsten Lamp and Flasher for Each Compartment.

an organization composed of retail merchants for the purpose of co-operating with manufacturers of food products in connection with their local and national advertising campaigns, has adopted what is known as the Gritt electrical fixture, a patented, interchangeable, electrically illuminated advertising sign.

The fixture has seven separate compartments or sections, each section operated with an individual flasher and illuminated with a 20-watt Mazda tungsten lamp.

The advertisements are photographic, hand-colored, transparent plates, 10 by 14 inches. Merchandise trademarks or packages are reproduced in original colors on these plates or slides. The various transparent colors with the electrically illuminated flash arrangement, give a very attractive display; one that has been found especially effective in groceries, meat markets, delicacy establishments, etc.

One of these fixtures is furnished to each member of the corporation, which has well over 1,000 members.

Local electrical contractors in each city are given the exclusive contracts to look after the installation and repair work of all the fixtures installed. These contracts run for five years and the electrical contractor is paid a fixed amount for each installation and a certain amount per month for looking after the repairs and slide changes and inspecting the fixtures, depending on the number furnished in the locality.

A NOVEL SOLDERING LAMP.

The accompanying illustration shows a soldering lamp designed for the use of linemen and electricians generally, but more especially for linemen working on telephone wires as there was no device that would perform the work satisfactorily.

The soldering iron is very slow and not efficient as it will cool before it can be taken to the top of a pole and a poorly soldered joint is the result; as for open flame lamps they cannot be considered as they will not remain lighted in a wind and if they do the flame will be so deflected by the wind that the wire will not become heated enough to solder. At the right we see the lamp with top extended to admit wire through slot at center. At left the candle holder base section is to be seen as well as the appearance of the lamp closed. The solder may be fed in at the top and the wind cannot blow out the flame, it is claimed by the inventor.

It Is Easy to Solder a Wire Joint in This Enclosed Candle-lamp Recently Invented. Can be Used as a Light Also.

RADIO WARNS SHIP OF HURRICANE.

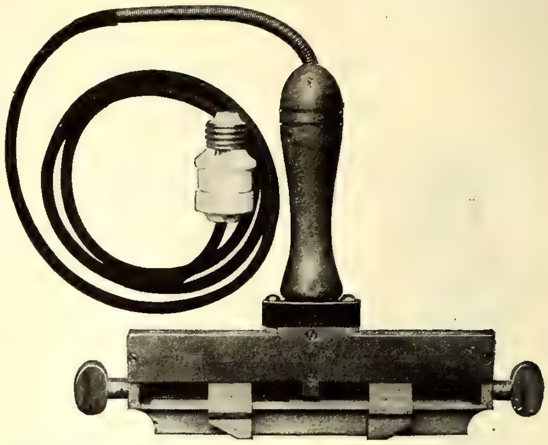
The steamship *Tivives,* of the United Fruit Line, was saved by the wireless service of the New York *Herald* from the hurricane which recently destroyed the United States cruiser *Memphis,* off the coast of Santo Domingo. The passengers also expressed appreciation of the daily news bulletins supplied by the *Herald's* service.

Eugene Magnus, one of the passengers, said that when Capt. A. D. Livingston, commander of the *Tivives,* received the wireless warning he put into a pier at Havana and remained there, coaling, until after the danger from the hurricane had passed.

"It is customary," he said, "for ships of the United Fruit line to anchor in Havana Harbor, some distance from the shore. But this time the Captain evidently decided that it would be safer to tie up to a pier and take on more coal to be doubly prepared for the storm. When we did get out only the rear end of the storm remained in our path, and this was so skilfully skirted by the *Tivives* that we experienced scarcely any inconvenience from it at all."

ELECTRICALLY HEATED HAND PALLET FOR BOOKBINDERS.

One of the latest aids to modern bookbinding is an electrically heated tool which is designed to take the place of the hand pallets largely employed in the bookbinding trade and usually heated over a gas stove. The electrically heated pallet is advantageous because within a few minutes after the current has been turned on all the heat that is needed is produced and the temperature of the device can thereafter be maintained constant. Of course with the electrically operated pallet no interruptions in the work are necessary for heating, as in the case with those pallets which are heated on a stove. The saving of time thus effected allows for a larger production within a given period. Furthermore, there is no dirt, as is the case when the pallet is heated on a gas stove. The type employed with the pallet can be easily and quickly changed, it is declared, a half turn of either one of the thumb screws shown in the illustration herewith releasing it, as the jaws work in opposite directions on a left-hand and right-hand screw. As it is made mostly of aluminum, the pallet is light and easy to handle. Special provision has been made to insulate the wooden handle thoroughly so that it is possible to operate the device continuously without any discomfort from



Bookbinders Will Find This Electrically Heated Pallet of Extreme Convenience and Efficiency.

heat. The energy consumption is small, only 110 watts being used. The device is designed to operate from an ordinary lighting socket and the heat controlled by a small rheostat.

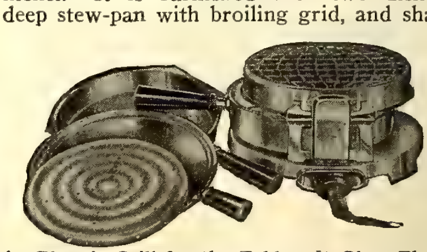
UNIQUE ELECTRIC GRILL FOR THE TABLE.

The electric *table range* has come to stay. In their eagerness to meet the demands of the household goddess for a table range that will do away with all guesswork in the adjustment of the heat to the various cooking operations, an enterprising manufacturer has placed on the market a new three-heat Radiant Grill.

This Grill operates from any lamp-socket, and cooking can be done both above and below the glowing coils—a great convenience and economy. It is equipped with three heats in such a way that it is a very simple matter to adjust the heat to the user's needs. The switch-plug is simply inserted at the different points in the plug receptacle marked *High, Medium* and *Low,* using 600, 300 and 150 watts respectively.

The "burner" is supplied with a heating element of very rugged design, of the open-coil-reflector type. It is made of exceptionally heavy gauge resistance wire and supported by high-grade mica insulated cross-bars. These bars are reinforced and protected by metal cross-rods which form a very strong grating for the cooking surface.

The Grill is made of heavy pressed steel, and every part finished in highly-polished nickel. It is furnished with two dishes, deep stew-pan with broiling grid, and shal-

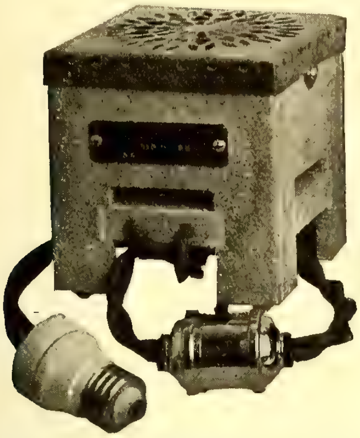


An Electric Grill for the Table. It Gives Three Degrees of Heat.

low dish. Also reflector (to concentrate heat on one operation) which may be used as a cover, and for a cake griddle. These dishes may be used either above or below the coils. Ordinary cooking utensils may also be used on it with equally as good success.

STONEWARE ELECTRIC STOVES THE LATEST.

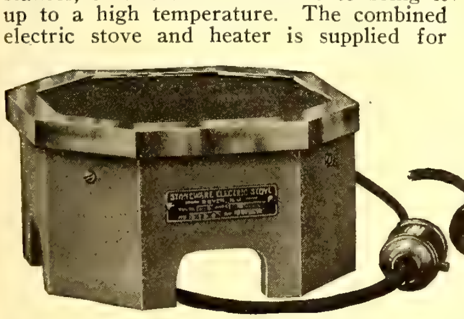
Stoneware electric stoves and heaters are the latest in the line of every-day appliances of this nature. The tallest model here shown represents a combined stoneware heater and stove, the smaller model that of a stove for light cooking.



The Latest in a Combined Electric Heater and Stove. It Presents a Most Pleasing and Artistic Appearance and Is Fitted with a Switch in the Attachment Cord.

The body of these stoves is made of a specially prepared, compress asbestos composition, capable of withstanding high temperatures. They are supplied in all shades of slate gray and reddish brown, smooth finish, or of raw tan, rough finish. The latter looks particularly well with fumed oak furniture. The heating element is made of flat Nichrome resistance ribbon. This has a considerably higher working temperature than the ordinary wire, such as is generally used for heating devices.

In the cooking stove (lowest one shown) every precaution is made to confine the heat to its upper face. The amount which can escape thru its sides and bottom is negligible and the heating wires are placed as near to its top as possible. As soon as the current is turned on heat is radiated to the object to be heated by the red hot wires—at least by the upper half of them—their lower side radiates its heat down to the upper face of the stove—called its radiating partition—for it is simply a partition of asbestos board (especially prepared to stand high temperatures), backed by air cell asbestos, to stop any heat from passing down. This radiating partition becomes hot and in turn radiates its heat to the object to be heated, so that soon the heat radiated down as well as that radiated up goes to heat the object on the stove. Asbestos absorbs so little heat as compared to metal, water and other substances, that it takes but little to bring it up to a high temperature. The combined electric stove and heater is supplied for various wattages, as also the smaller model electric stove, the amperage ranging from 1 to 6 at 110 volts.



Another Style of Stoneware Electric Stove for the Table.

A NEW TRANSFORMER-RECTIFIER FOR CHARGING BATTERIES.

The apparatus here pictured is a device that enables you to charge a 6, 8, 12, 18 or 24 volt storage battery from an alternating current circuit, by screwing the attachment plug in any socket where there is alternating current. Then two wires are run from the proper terminals to the storage battery to be charged. The latter may be left on the car. When the socket key is turned the battery will receive a direct current.

The instrument passes a current of about two amperes or a little lower if the voltage of the battery is high. With this current, you can charge a battery of any ampere-hour capacity if time is not limited. A charging over night will put a discharged battery in serviceable shape, and if the latter is of large ampere-hour capacity, the current may be left on long enough to effect a complete charge, or it may be put on at different times and the same result accomplished. Charging the battery at regular intervals is very good practice.

The charging set is completely automatic in that there are no regulating appliances, and it does not matter whether it's a 6 volt battery or 24 volts, or anything in between. The device cannot be overloaded or burned out. The pressure or voltage of the circuit from which current is taken is reduced by means of a transformer of special design. The current, reduced to the proper pressure, passes out of transformer and goes thru rectifier and storage battery.

The apparatus contains an electrolytic rectifier of few parts. After long use, depending upon amount of work done, one electrode will be consumed and a change of fluid required. Replacements can be made in a few minutes' time at a cost that will be equivalent to not more than five cents for the full charging of a 60 ampere-hour battery, it is claimed. It is about the same in size as the average automobile lighting storage battery, 6¼ inches wide by 12¼ inches long by 11 inches high, weighing 45 pounds, and can be carried in the car for use while touring. A direct-current ammeter secured to the cover forms part of the circuit and indicates at all times the charging current passing into the battery.

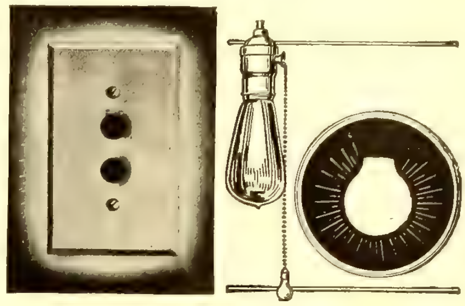
Something New in Battery Charging Devices—A Self-Contained Electrolytic Rectifier, Step-Down Transformer and Ammeter.

NEW LUMINOUS SWITCHES AND SOCKETS SHINE IN DARK

There is something new under the sun at last in the form of self-luminous electric switches and sockets which glow in the dark and are thus easily found.

The small bulb attachable to chain pull sockets is permanently luminous and can be plainly seen all night if left hanging during the day where it can get light. Artificial light will also cause the bulb to shine.

The use of this bulb will save a great deal of wiring expense, and will make pull chain lighting more popular than ever, say its sponsors. No more swinging around in circles to find the chain; no striking matches to find the light.



Have You Found it Difficult to Locate the Electric Switch or Lamp in the Dark? These Luminous Switch Buttons and Pendants Glow in the Dark.

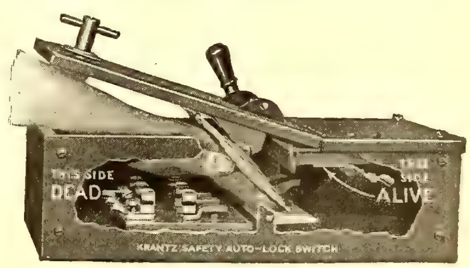
MARRIED BY TELEGRAPH.

Private B. J. Linhart of a Missouri regiment at Laredo, Tex., and Miss Ruby Swartz at Butler, Mo., were united in marriage by telegraph recently, thru the intermediary of an operator and a clergyman at each office. After the ceremony the bridegroom was showered with rice by his brother guardsmen.

A new hydro-electric power plant has been opened and placed in service in Utah, where energy is transmitted to Salt Lake City, 135 miles away.

SHOCK IMPOSSIBLE WITH THIS SWITCH.

A new electric service switch known as the Safety Auto-lock Switch, shown herewith, effectually precludes the possibility of the manipulator receiving any shock whatsoever. In this switch, the movable part of the switch is attached to the cover of the inclosing box in such a manner that the box cannot be opened when the switch is closed. Furthermore, *live* parts cannot be touched when the cover is opened, since a barrier is swung into place between the *live* terminals and the open end of the box when the cover is raised. With the cover raised the fuses are always left dead. Holes are provided in the lugs on each side of the switch-handle so it may be held in the open position with a padlock. Means is also provided for locking the lid of the box closed. All parts are interchangeable and the blades can be replaced without disturbing the wiring connections.



This Switch Automatically Disconnects the Current When the Cabinet is Opened.

Three electric passenger busses run to outlying districts in Dubuque, Iowa, as adjuncts to the existing trolley system.

DIPLOMAT OBEYS WIFE'S RADIO PLEA FOR A HAT.

Señor Julio de Betancourt, Columbian minister to the United States, performed a delicate mission aboard the United Fruit liner Almirante recently which won him the admiration of all on board. Acting on wireless orders from one of his superiors, he met the ship at Quarantine, gingerly carrying a large box. A steward hurried with it to one of the staterooms, while Señor de Betancourt anxiously paced the deck.

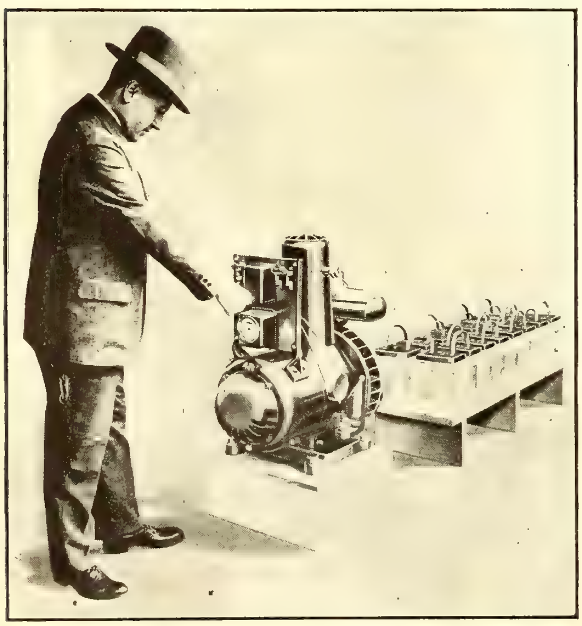
Presently the stateroom door opened and out walked the minister's wife. She wore a brand new Fifth Avenue spring hat and beneath it a happy smile. The diplomat saw the smile and breathed a sigh of relief. His wife had lost her hat overboard, he explained, and sent him this wireless message:

"Lost hat. Meet me at ship with new one."

A COMPACT ELECTRIC LIGHTING OUTFIT.

The accompanying photograph illustrates a very compact electric generating unit recently developed. This is intended for private use where power lines are not available, such as in suburban sections of the country.

The complete outfit consists of a gasoline engine of the air-cooled type, directly coupled to a dynamo. Over the dynamo, the switchboard is mounted. Upon this panel are arranged the various controlling devices. The generating output of this unit is 750 watts at 32 volts. The engine is started by closing the battery switch which connects the dynamo to the battery, thus causing it to act as a motor momentarily. The engine is started as soon as the proper speed is attained. The motor connection is automatically thrown out of the circuit, and the dynamo line is switched in so that it charges the storage batteries, used as reservoirs of electrical energy. A special ampere-hour clock is supplied on the switchboard to indicate the condition of the storage battery, whether in a fully charged or an uncharged condition. Thus the person operating this outfit can tell at a glance the amount of current he has already consumed and when it is again necessary to charge the batteries. The size of the complete outfit can be compared by the size of the man standing near the switchboard. This outfit should find many friends among the country folks, farmers, and suburbanites.

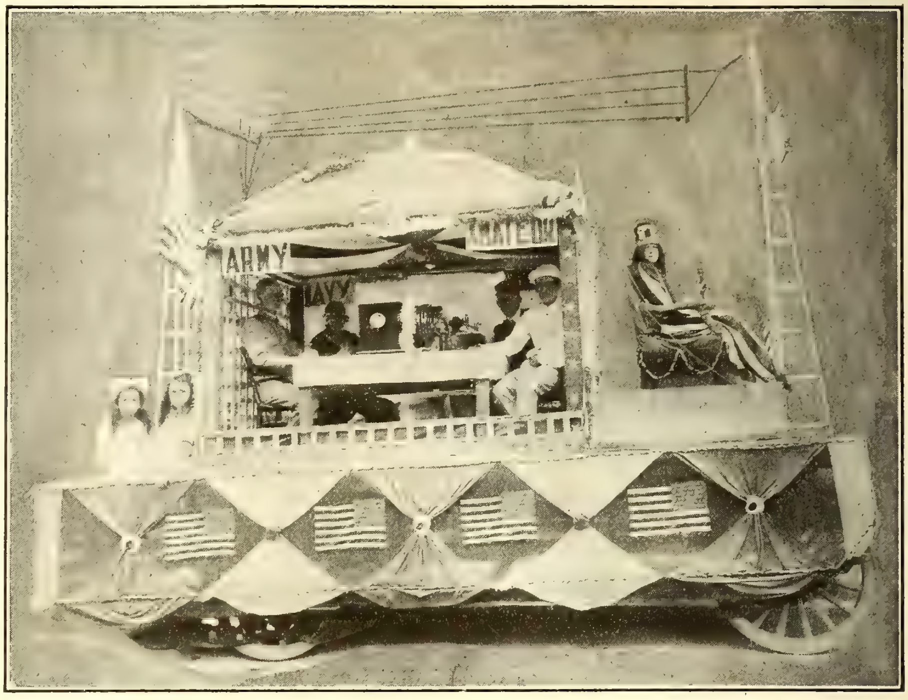


One of the Latest Isolated Type Electric Lighting Plants. Extremely Complete Even to an Ampere-hour meter.

Newport's Radio Float

By Lloyd Manuel

When plans were being formulated for the Fourth of July preparedness parade held in Newport, R.I., the author suggested to the committee in charge that a float featuring *Radio* as a preparedness measure, be displayed. The committee requested that he design and build such a float, with the result here pictured.



A Wireless "Float" of More Than Passing Interest. It Appeared in a Parade at Newport, R. I., Recently, and Created a Very Favorable Impression.

As it was a daylight parade, the author did not feature the transmitting end as much as he might have, had the parade been held at night. A beautiful effect could then have been obtained.

The transmitting set consisted of a one-inch coil charging a moulded type condenser which discharged through a fixed gap. On account of their portability and due to the fact that the parade was of but two hours' duration, dry cells were used. A spark which could easily be heard a thousand feet in the open air was obtained. In addition to this an auto vibrator buzzer was used. When the spark was not being worked, the buzzer was kept going, spelling out patriotic items. For the display, an E. I. Co. Tesla coil was mounted on the table, also two inductive helices. Also a Blitzen key and a Fessenden commercial key was used. An Edgecomb-Pyle Rotary and close core transformer were shown.

For receiving the writer requested the use of the sets belonging to "1TD" and "ITG." They readily acquiesced and thus the two finest Audion sets in this section of the state were obtained. These sets are made of solid mahogany with a hard rubber front and are a great credit to their owners, who are also the designers. They are excellent pieces of work and enhanced the beauty of the float.

The aerial, consisting of four polished copper wires, was supported between two nine foot latticed towers, and was of the inverted "L" design. Electrose insulators were used at either end. Four operators were seated at the operating table—Arthur W. Manchester dressed as a soldier, Harry Tilley as a sailor, Charles G. Cook as a commercial operator, and the writer as the amateur. Mr. Manchester is one of the best amateur operators it has been my pleasure to meet and has a worthy second in Mr. Tilley.

When this float put in its appearance the population received it very enthusiastically. The applause along the route was constant and satisfied us fully.

WIRELESS JOBS FOR BLIND SOLDIERS.

It is an established fact that the blind far excel in acuteness of hearing and sensitiveness of touch their fellow men who have unimpaired sight. The French, with their usual forethought, have taken this into consideration in planning for occupations for French soldiers after the war. French scientists, after careful investigation, have decided that blind soldiers will make the best wireless operators.

The qualities most needed by a wireless operator are highly developed faculties of touch and hearing. In most cases, people who have been rendered blind not only retain those two faculties intact, but develop them to a remarkable degree of acuteness and sensitiveness.

Another valuable service which the French scientists believe the blind soldiers could render especially well is that of detectors on shipboard during a fog. Where a man with unimpaired sight is at a loss to locate the vessels whose fog horn he hears in the darkness, a blind man with sharpened hearing could locate it absolutely.

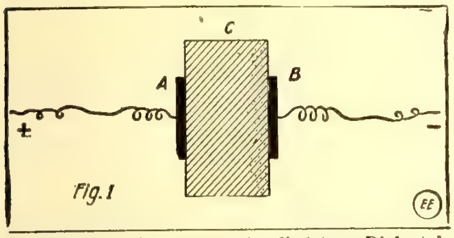
In opening these positions to her blind soldiers, France will not be performing any charity in the common use of that term. She will simply be fitting the best man to his job, and giving the men who fought for her their deserved opportunity. The benefit derived will be for the public as well as the individual.

The Marvels of Modern Physics

By Rogers D. Rusk, B. Sc.

Opportunities for the Experimenter.

THERE are more opportunities in scientific work today than ever before in the world's history. The ever-widening circle of scientific knowledge has grown in the last century by leaps and bounds, until it now touches a multitude of fields and an infinite number of problems. If the old saying that there is always room at the top was ever true it certainly is with respect to the scientific professions, for the more there are at the top, the more room there seems to be. The difficulty, as in all other walks of life, is to reach the top, and the present paper which concludes a series of twelve on special subjects in modern Physics would aim to show what is actually being done today in Physics and what the requirements of such work are.



How an Electric Current Applied to a Dielectric "C" Causes a Soaking Effect; the Dots Representing the Electrons. One of the Mysteries of Electro-Physics.

A few years ago Lord Raleigh noticed a very slight difference in the behavior of nitrogen gas extracted from the air, and nitrogen obtained by other chemical means. A careful investigation proved that nitrogen from the air contained an extremely small proportion of a very rare gas existing in the earth's atmosphere, and hitherto unknown. This gas he called *Argon*, and already its discovery has proved of both theoretical and practical importance. It was the first of a series of new elements to be found which are chemically inert—Argon, Helium, Neon, Krypton and Xenon, and it is now being put in the latest incandescent lamp bulbs on account of the improvement it makes in the quality of the light. All this resulted from Lord Raleigh noticing a *slight difference* between two samples of nitrogen.

Quite frequently it happens, as in the above case, that a great scientist is not one who possesses an extra sense enabling him to look far into the future, and reveal what is hidden there; but that he is one who has trained himself *to note minute differences*, and to investigate the actual causes of phenomena. Just as Sir Isaac Newton watched a falling apple and discovered the universal law of gravitation, so may some scientist at this very moment be on the high-road to fame thru his attention to what others have past over as too insignificant or too commonplace to investigate.

Few of us, however, will ever become famous scientists, and not a large number will even be able to spend very many years in a university studying and preparing for such work. Consequently it is well that there are several avenues of approach, and that there is a place for the man of practical experience, and mechanical ability, as well as the man of theory—for both qualities are seldom found to the same degree in one individual. A striking example of what two individuals of opposite abilities may accomplish together is shown by the work of Henry A. Rowland and his assistant, a man of marvelous mechanical ability. Rowland himself invented and developed the theory of the concave diffraction grating, an optical device by which he was able to measure the length of light waves to the thousandth of an Angstrom unit.* This grating consists of a concave metal mirror upon which are actually ruled an immense number of very fine lines which act as parallel bars, prohibiting the passage of the light except between the lines. The great difficulty was to rule these lines accurately, but after many failures a machine was produced that would rule as many as 43,000 lines to the inch. So delicate was the machine that the temperature of a person in the room affected it, necessitating its operation in isolation, and other American and European scientists attempted in vain to imitate it. Rowland and his assistant, Schneider, died some fifteen years ago within a few weeks of each other, but their work will live, and it is interesting to note that only recently has a successor been able to manipulate the machine which Rowland and Schneider so skillfully constructed and used.

New Experimental Physics Series

The February number of THE ELECTRICAL EXPERIMENTER *will contain the first installment of a new series of "Experimental Physics" prepared by Professor John J. Furia, A.B., M.A., F.K.S., instructor of Physics in a leading American college and who possesses the faculty of writing easily understood articles on the every-day applications of the fundamentals of pure physics.*

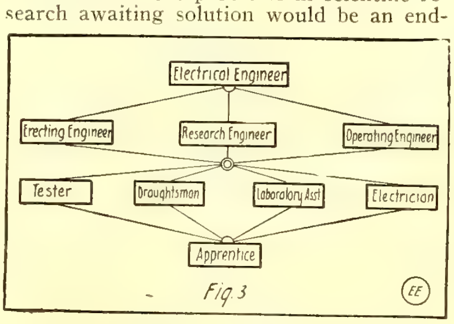
The series will continue thru twelve installments, each one dealing with some vital and interesting physical phenomenon such as—Photography, Magnetism, Electricity, Hydrostatics, Newton's laws, etc., etc.

This series of articles we feel sure will meet with the approval of all of our readers, as extremely simple experiments are given in each chapter which any one can perform, so as to satisfy themselves of the physical laws involved at an insignificant cost, and in most cases with odds and ends found about the household.

We believe that such a series of articles will be of more than ordinary interest as "Physics" represents the basis of all scientific phenomena and the practical every-day applications thereof.

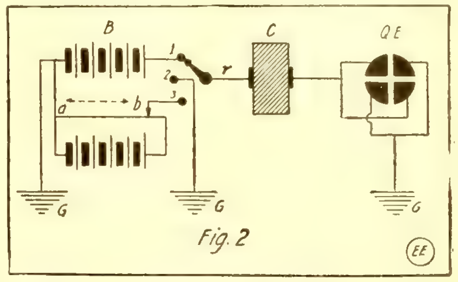
Every student of electrical and associated subjects must perforce have a well-grounded education in the elements of Physics and be able to express himself on these.

To mention the problems in scientific research awaiting solution would be an endless task, but a suggestion of the general fields of research may be more profitable. Among the greatest physicists of recent years may be mentioned Thompson, Einstein, Planck, Lorentz, and Rutherford. Thompson has directed untiring efforts in an attempt to solve the question of the constitution of matter. His study of *atomic structure* is monumental. Rutherford has attacked the same question from the field of *radio-activity* and is the world's highest authority on this subject. Planck has suggested a new theory of dynamics, the Quantum *theory*, which is now in its infancy, from his study of radiation. Lorentz and Einstein are known for their mathematical research, the latter having presented in 1905 his so-called *principle of relativity* in which he attempts to define the relation between the ether and the motion of the earth. His theory, however, is deeply philosophical and mathematical. These men have attacked directly the biggest possible questions. They are the same old questions as to the real character of matter, ether, and electricity, and we will probably only approach their solution so long as scientific research continues. Several eminent philosophers and scientists have said that we should not attempt to formulate such theories about the ultimate nature of things and their relations, because they cannot be proved, and that science should content herself merely with describing and analyzing the facts of experiment.



Showing the Paths Leading to the Title of "Electrical Engineer."

*Note.—Altho an error was subsequently found in Rowland's work, much of it is still standard.



Manner of Measuring the "Soaking Effect" of Dielectrics with a Quadrant Electrometer.

Others in the scientific world have been attacking these same problems indirectly by trying to further our knowledge of many important but little understood phenomena. For example, the *soaking effect* in a condenser has long been a mystery, and several eminent scholars have been studying it recently. As everyone knows, a condenser does not conduct a direct current, but stores up a certain charge on its surface. This is all very plain, but it has also been noticed that a certain amount of the charge disappears from the surface. If such a condenser is composed of two plates A and B and a dielectric C, Fig. 1, it has been found if the plates are charged, and then suddenly discharged to earth, that a minute current can be obtained for a short time from the dielectric itself. The small part of the charge which disappeared from the surface *actually soaked into the dielectric*, and now soaks out again in the opposite direction to that which it went in. This effect was first noticed some time ago by Curie and others, and recently Richardson has measured the voltage of this soaking current in quartz and Iceland spar. He calls it the polarizing E. M. F. of the crystal, and of course it is extremely small and varies with the applied E. M. F. His method of measuring the polarizing E. M. F. is comparatively simple.

The apparatus is arranged as in Fig. 2, so that by putting the switch on point 1, the condenser is charged by the battery B. The

(*Continued on page 691*)

The Presidential Amateur Radio Relay

A Message from the "Big Chief"—9XE

THREE hours of real wireless fun and testing of various receiving apparatus was offered to you on the night of October twenty-seventh, Radiobugs. From the great amount of interest that was shown we are led to believe that it is the kind of work you like.

For the benefit of a few doubting Thomases in the east, we want to state that the permission to run this relay was received from the White House direct, from the secretary to the President of the United States. The Acting Secretary of the Navy, the Hon. Mr. Benson, also gave the permission and it was referred to him from the White House before we received the open order to go ahead.

Every amateur in this country was communicated with, direct or thru his Radio Club or another station in his town.

NAA and NAJ did not send out the warnings as planned because we withdrew the request when we were convinced that some were trying to make this a political move. Events have proved that if their contention was correct, that we not only know all about corn and crops out here but sure do know how to pick a winner against heavy odds. From the many thousands of signatures that we have on file it also appears that we innocently re-elected the President.

The relay was started by 9XE, who transmitted with a one-half inch spark coil connected to a regular oscillation transformer of the pancake type. The coil was going all along, and for a sending wave we had about one-half of the O.T. short-circuited by the sending key when it was prest. This compensating wave past thru the regular telephone wires, and as the receiver was off at 9XE, and also at 9XR two miles away, the wave worked the Hall *wireless relay* device, which is a sound actuated relay, and this automatically sent the message by working a magnetic key at 9XR.

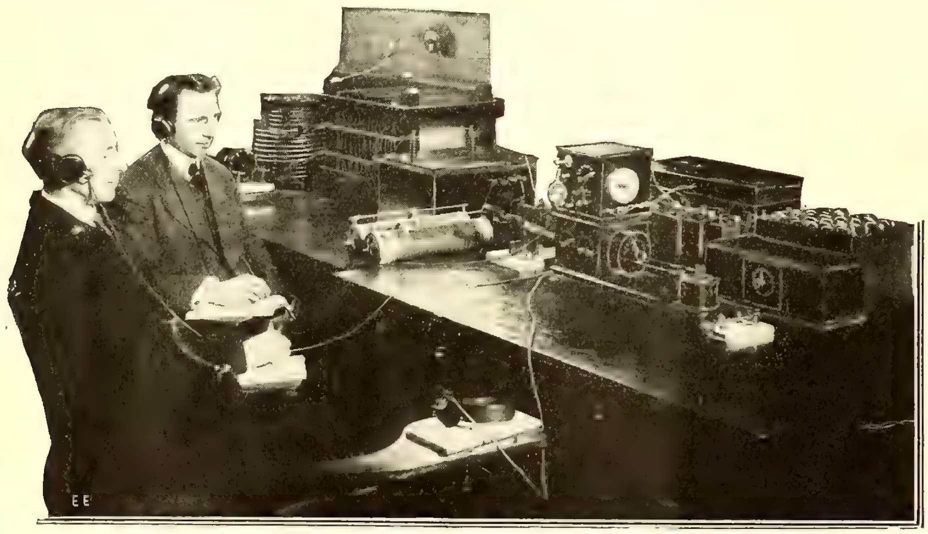
The relay as conducted was perfectly fair and was open to all radio amateurs broad enough to see the advantage of it. The main idea of the relay was to obtain some idea of the "real range" of the various sending stations under adverse conditions.

Every sending station had a copy of the MSG (message) ahead of time and had instructions to repeat a certain letter in a certain marked word, and all had different marked words. By this means not even the writer knew the exact word letter that would be repeated. Some very remarkable distances were covered and some excellent receiving records made.

A great many Government and commercial stations were working at the time of the relay as well as numbers of amateurs, who appeared to be wilfully interfering. Thruout, however, the results were most gratifying and interesting.

No special interests were served in this relay as far as the writer knows, but one or two were ignored because the writer did not care to have anyone receive the credit for running the relay, as they did on the Washington's Birthday Relay of last year.

I am not trying to commercialize your interest in the relay work, and there is no string tied to the prizes. Neither are you urged into a mad race for subscriptions for this or any other magazine to earn this prize. It is human nature to enjoy a pat on the back for work well done, and that is what you are getting now. Bigger and better prizes will be offered later on to the best amateur station in the country for all around work, so you had better get busy. And don't forget that the author is assuming all responsibility about giving the prizes.


Prize Winner of Presidential Relay—Peabody High School of Pittsburg, Pa.

Incidents of the Relay

P. Stover, of Marengo, Iowa, claimed to have heard 6SH and 1ATY. The first station is in California and the latter in Connecticut. Not checking the mistakes cost him his chance for a good credit. Chester Sinnett, who lives on Bailey Island, off the coast of Maine, clearly read 8AEZ and 4DI, checking their mistakes and earning two good credits.

Station 5DU in Dallas, Texas, was clearly read by the author and did remarkable work. For sending the stations are listed as follows in the order of their apparent superiority—8AEZ, 8NH, 5DU, 9ABD, 6SH, 8NF, 9IC, 8JZ, 7YS, 7ZS, 2ZB, 8SK—and we came very near forgetting 9IK, which is really fourth on the list. A look at the list will explain the game better. 9DK, Oneill of St. Louis, volunteered to take the place of 9ACE, who was called away at the last moment. Emmerton of Sawtelle, Calif., was listed as 6QJ thru an error, his call being 6TQ. Some stations were not heard at all, probably because their *sigs.* were not leaving their spark gap, and there appears to be a heap of them around the country just like this. Some stations, like 7YS, 7ZS, and a few others, are hundreds of miles away from any one, and the fact that they were heard shows that they actually do work remarkable distances.

One good thing about these relays is that we are interesting the amateurs in the south and west where good stations are needed in the event of war. Publicity relays are the only kind of relays that are going to be any good to you, until you all are officially recognized by the Government as a factor in its Third Line of Defense.

Robert Higgy, late of the Lima High School, Ohio, was at his new home in Phoenix, Arizona, with the receivers strapt on as usual. He caught the MSG from 5DU and also heard 9NN talking about it with 5DU. This is the kind of sending that you boys want to do, and don't let anyone tell you that this is freak work.

For instance, station 8NH received 6 credits for checking six stations, as did also 9MK, and all of these will count in the final round-up to award the prize to the best all around station for sending and receiving.

The next relay will be something entirely new and novel, and as the moss-grown elders would say, "A Publicity Relay."

The Prize Winners.

8YZ, Peabody High School, of Pittsburg, Pa., is awarded the second prize of *One Tubular Audion Panel, Assembled,* with two filament bulb, rheostat, and ready to be connected up for use, for obtaining 1,893 signatures of American citizens. This panel has been most graciously donated by the National Electric Mfg. Co., Mallers Bldg., Chicago, Ill.

2AGJ, J. K. Hewitt, of Albany, N.Y., turned in 861 signatures and receives the 3,000 ohm pair of 'phones of the remarkable 55 type, unconditionally donated by the Wm. B. Murdock Co., of Chelsea, Mass. This is the third prize.

The Ames Radio Club of Ames, Iowa, turned in 777 signatures, and evidently had a lucky combination of figures; anyway they are awarded the fourth prize—a pair of 2,000 ohm 'phones donated by the Wm. B. Murdock Co., of Chelsea, Mass. This is the new club just formed of some very progressive amateurs, and you will hear more from them later.

9HQ, Owen R. Terry, Stoughton, Wisconsin, receives the fifth prize for turning in 716 signatures to the MSG. This will be one two-filament tested Electron Relay, donated by the Pacific Research Laboratories of San Francisco, Cal. This company would not consider any other arrangement but that the writer permit them to give ten of these prizes to the lucky winners.

The following will get an Electron Relay from the above company:

J. I. Greene, Rock Falls, Ill., 714 sigs. A newcomer in the game.

9RD, F. M. Bailey, Clinton, Iowa, 554 sigs. An old war-horse, with a son 21 years old.

9NY, R. O. Strock, Polo, Ill., 502 sigs. An ardent worker. Watch him for results.

Glenn Fordyce, Anita, Iowa, 338 sigs. This little fellow is a "newsie."

9IK, R. W. G. Mathews, Chicago, Ill., 315 sigs. A pleasant fellow, hard worker and A No. 1 amateur.

9ACM, A. E. Jeffrey, High School, Goshen, Ind., 281 sigs. A busy school teacher who finds time for a little recreation that also interests his pupils.

1IZ, Robert T. St. James, Great Barrington, Mass., 279 sigs. A bright star in the east.

(*Continued on page 682*)

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

H. Gernsback, Manager

New Wireless Law Planned

Members of the Radio League of America as well as all others interested in Radio telegraphy and telephony, will note that a new Wireless Law has been proposed, to supersede the Radio Law of August 13, 1912.

Before we go any further, we call to the attention of all concerned that the new Act, providing it will be past, will not in any way be detrimental to radio interests. Quite the contrary, due consideration has been given to amateurs as will be seen by perusing the draft of the proposed Law.

We have printed below the letter of the Radio League of America to Mr. D. W. Todd, in response to his letter of November eleventh, and it will be seen that we recommend that radio amateurs owning receiving stations only should be included in the new Wireless Law, the recommendation being that such stations should not be required to be licensed, but that they should be subject to the section 15B, which calls for secrecy of all messages received and a penalty for divulging the contents of any message.

By reading the proposed draft carefully, it will be noted that, as far as the amateur is concerned, it is identical with the present law. So amateurs need not have any misgivings, at least for the present.

The proposed new Radio Law has been primarily originated to keep foreign governments from planting wireless stations in the United States which could be used to violate our neutrality in times of peace, when foreign Governments are at war. No patriotic American can fail to endorse the new bill on account of this.

Radio amateurs may rest assured that the Radio League of America will see to it that amateurs will get due consideration and that nothing detrimental shall be undertaken against them without all being informed before any new Law should go into effect.

MR. TODD'S LETTER.

Address:
Chairman, Inter-Departmental
Committee on Radio Legislation,
Room 273, Navy Department,
Washington, D.C.

INTER-DEPARTMENTAL COMMITTEE ON RADIO LEGISLATION
Washington, D.C.,
November 11, 1916.

RADIO LEAGUE OF AMERICA,
233 Fulton Street,
New York City.

Gentlemen:

An inter-departmental committee appointed to consider suggested changes and amendments to the so-called Radio Act of August 13, 1912, has prepared the inclosed draft of a bill which it is proposed to have introduced at the next session of Congress as a substitute for the present Radio Act mentioned above.

A copy of the draft prepared is inclosed herewith for your information. The Committee desires to meet interested parties informally to get the benefit of such comments and recommendations as they may choose to make, at 10 a.m., Tuesday, November 21, 1916, in Room 1023-A, Department of Commerce, 19th Street and Pennsylvania Avenue, Washington, D.C. Should you not wish to be represented at the meeting, the Committee would be glad to receive your written comments and suggestions.

Please acknowledge receipt, and state whether or not you will be represented, and, if so, by whom.

Respectfully,
(Signed) D. W. TODD,
Commander, U.S. Navy,
Chairman.

REPLY OF RADIO LEAGUE OF AMERICA.

THE RADIO LEAGUE OF AMERICA.
233 Fulton Street,
New York, Nov. 18, 1916.

D. W. Todd, Esq.,
Commander, U.S. Navy,
Chairman, Inter-Departmental
Committee on Radio Legislation,
Room 273, Navy, Dept.,
Washington, D.C.

My dear Sir:

Thank you for your letter of November 11th, enclosing draft of a new bill which is to be introduced at the next session of Congress, this proposed bill to supplant the Radio Act of August 13th, 1912.

As Manager of the Radio League of America, I represent directly the largest body of radio amateurs in this country and as such, the recommendations I shall make below, naturally concern only the vital interest of the radio amateurs of this country.

The fact is probably known to you that the writer who was the founder of the now defunct "Wireless Association of America" has always striven, not only to protect the radio amateurs' rights, but also to see to it that Government and Commercial stations should not be interfered with by irresponsible amateurs. Before 1912 amateurs continually interfered, today such interference is practically unknown.

As is probably known to you, the writer is responsible for the idea of restricting amateurs to a 200 meter wave length, as well as restricting them to the use of no larger input than 1 k.w. The writer's recommendation first published in his editorial in the February 1912 issue of *Modern Electrics* was subsequently embodied in the Radio Act of 1912, and as far as the writer is aware of, the idea has proved eminently satisfactory to all concerned.

Before proceeding, allow me to place before the Commission several relevant facts, not apparent at first glance.

Radio amateurs of today may be broadly classed in two groups:

1° Those who own transmitting and receiving apparatus.

2° Those owning only receiving apparatus.

Group one was thoroly covered by the 1912 Radio Act, while the Act said nothing about group two.

This is as it should be for the Radio Amateurs owning receiving stations only—and they total probably over 90% of all amateurs—can hardly ever cause mischief. For, if the message is of an important nature, it is usually sent in code, therefore unintelligible to the amateur. Un-coded messages, as far as their secrecy is concerned, are covered by the Radio Act, section 19, which makes the unauthorized divulgance of any message punishable by a fine.

But since the Radio Act of 1912 a new condition has arisen, namely Radio Time service. At present when several of the powerful Government stations are sending out time signals at noon and at 10 p.m., as well as sending out weather reports, thousands of "amateurs" who are jewelers and the like, depend directly upon their radio outfits for this important service.

For this and other apparent reasons, I recommend that the new Act should contain the following addition. It could be added to Section 18 of the proposed Act, as follows: (The capitalized sentence showing the proposed addition.)

Sec. 18. General amateur stations shall not use a transmitting wave length exceeding 200 meters or a transformer input exceeding one kilowatt.

NOTHING IN THIS ACT SHALL BE CONSTRUED TO APPLY TO THE RECEPTION OF RADIOGRAMS, RADIOPHONE MESSAGES OR RADIO TIME SIGNALS BY AMATEURS OPERATING RECEIVING APPARATUS ONLY. SUCH STATIONS ARE NOT REQUIRED TO BE LICENSED BUT THEY ARE SUBJECT TO THE REGULATIONS UNDER SECTION 15 (b).

Under the proposed Sec. 9 No. 4, the writer would recommend the following addition: (Capitalized.)

4. Apparatus other than that specified in the license shall not be used for radio communication, **EXCEPTING AMATEUR STATIONS. SUCH STATIONS ARE PERMITTED TO CHANGE THEIR APPARATUS, IF IN THE DISCRETION OF THE DISTRICT RADIO INSPECTOR, SUCH CHANGES ARE CONSIDERED REASONABLE.**

No further recommendations or suggestions can be made by the writer, but he takes this occasion to congratulate the committee on the patriotic changes embodied in the proposed Radio Act. It will certainly be a big step towards upholding the neutrality of the United States when foreign nations make war upon each other. We seem to have profited by our disagreeable experiences of 1915.

Thanking you in advance for keeping the writer informed of the progress of the new bill, he remains,

Yours very respectfully,
RADIO LEAGUE OF AMERICA,
(Signed) H. GERNSBACK.
Manager.

PROPOSED NEW RADIO LAW.

AN ACT TO REGULATE RADIO COMMUNICATION.

Sec. 1. Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That wherever used in this Act the term "radio communication" shall be construed to mean communication by any system or method of electrical communication without the aid of wire or other conducting connection; the word "apparatus" to mean machines, devices, and all other equipment used in radio com-

(*Continued on page 671*)

RADIO DEPARTMENT

Election Returns Flashed by Radio to 7,000 Amateurs

SEVEN thousand wireless telephone operators within a radius of 200 miles of New York City received election returns from the *New York American*. Three hundred and fifty moving-picture theaters; special bulletin boards in different parts of the city, and the principal hotels of Manhattan obtained the news from the above office, as fast as it was received. Fifty extra telephone lines were run into the *American* office, the theaters were placed on lines that were in continuous operation, and while the news of the closest Presidential election in years was being given to the public thru these channels, the editorial staff compiled the returns without the slightest confusion.

How the "Election Returns" Gathered by the "New York American" Were Spread Broadcast to 7,000 Waiting Amateurs by Wireless Telephone from the de Forest Laboratory Near New York.

When the returns came in, indicating the election of Hughes, and the first edition was prepared for press at 11 p.m., the heads and the reading matter inclined that way. Later there was a change, a doubt was cast, and then the tide drifted Wilsonward. It ebbed and flowed, from one candidate to the other, for several hours. Thru the clearing house all outlying district information was gathered, in an effort to sweep aside the uncertainty. Then the headings, which were studies in clarity and terseness, were altered, the introductions and summaries were changed, and Wilson was featured as the winner. The wireless-telephony feature was remarkable. The 7,000 amateur radio operators were all notified in advance, and the news was supplied in the most systematic manner, thru the circulation department, by an expert from the editorial rooms, who took his bulletins from the same source as the fifty operators who supplied the moving-picture shows, hotels, and bulletin-board operators.

Realizing that all men cannot grasp a spoken message alike, or in the same time, and because it was impossible to stop and answer questions, a black-board was erected, in view of all the operators. The bulletins were written on this and reading from it, the operators telephoned the news to the different points. In the picture theaters the messages were transmitted to slides and flashed on the screen.

The amateur wireless operators located in different towns about New York gave out the information, and allowed others to *listen in*. They heard not only election returns, but music as well.

Over their heads, reaching from that droning desk in the *New York American's* office to the white bulletin boards on which their eyes were fastened, a vast network of electrical waves were meshing and passing. On these unseen waves the news they sought was carried.

From the deep semi-circular desk the news had been flung by telephone to the de Forest Wireless Telephone Laboratories at Highbridge on the Harlem River. Up in the de Forest tower sat Walter Schare, an unassuming chap, who listened thru a receiver clamped to his ear.

At Schare's hand was the wireless telephone transmitter switch. As he heard the news from the seventh floor of the great red building near Brooklyn Bridge he snapt it forth to 7,000 anxious amateur wireless operators within that great 400-mile circle.

Between the bulletins, music was sent thru the clouds. The crowds heard "The Star Spangled Banner," "Dixie," "Columbia, the Gem of the Ocean," "America," "Maryland," "Yankee Doodle" and all the other anthems, songs and hymns that Americans love.

The radiophone equipment consists of two large Oscillion tubes, used as the generators of the high frequency current, which may be seen on the panel. They develop one-half kilowatt of energy and this charges the antenna. The high potential current is obtained from a 1500-volt direct current generator, driven by a constant speed motor. This high tension current is controlled by suitable rheostats and shunted with capacities so as to reduce the inductive reactance as much as possible in the oscillating current. The filaments are lighted by 110 volt direct current. The oscillating circuit comprises a number of capacities and inductances properly balanced in the circuit. The voice-current modulations are derived from a microphone, inductively coupled to the high frequency circuit. Another microphone connected in parallel with the first by a switch, is used in conjunction with a phonograph. The operator standing near the microphone is Charles Logwood, chief engineer to Dr. de Forest, and a great deal of credit is due him in the development of the radiophone employing the Oscillion tube as a generator of radio frequency currents.

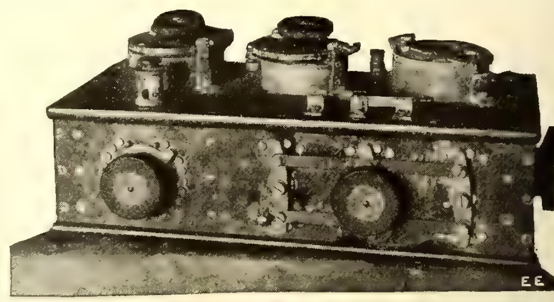
Dr. Lee de Forest gave a demonstration of transmitting music by wireless at the Hotel Astor, New York, on the evening of October twenty-sixth. Columbia phonograph records played from the laboratory of the company at 102 West Thirty-eighth Street were distinctly heard in the receiving room of the Astor, with the exception of a few interruptions by the powerful naval wireless apparatus at the Brooklyn Navy Yard, when the warning of a storm was heard intermittently with the music.

The U.S. Radio Bureau has been informed that the following land stations in Alaska have been closed for the season, and will not be reopened until March, 1917: Akutan (KNW), Chignik (KHC), Egegak (KMF), Hales Creek (KMT), Koggiung (KVV), Koggiung (KHB), Nahnek (KHT), Naknek (KMK), Nushagak (KMG), and Snag Point (KHF).

A WIRELESS TUNER OF MANY WAVES.

The accompanying photograph shows the multiple radio tuner (a portion of the wireless receiving apparatus) of the ill-fated steamship *Falaba*, after lying on the bed of the ocean from the third of March until the twenty-ninth of October, 1915.

On the latter date it was pickt up in a trawl and delivered to the Receiver of Wrecks at Milford Haven, subsequently being forwarded to the London Office of the Marconi Wireless Telegraph Company. It has suffered surprisingly little considering the vicissitudes thru which it past.

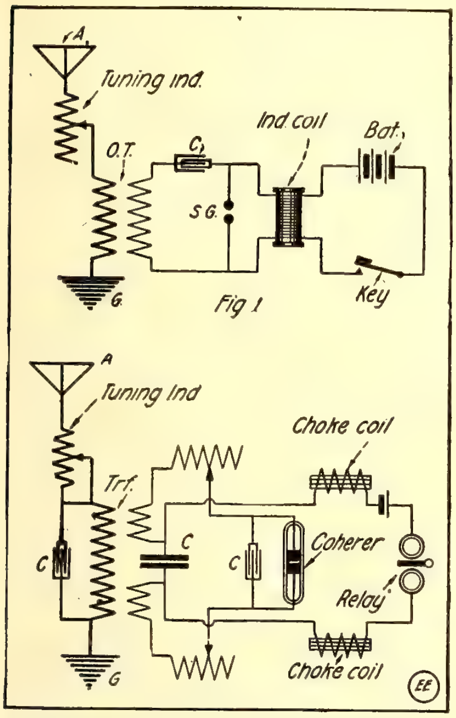


Appearance of Radio Tuner from Ill-fated Steamship "Falaba," After It Had Lain on Bed of the Ocean for Eight Months.

Marconi Company Sues the U. S. for $1,000,000 Damages

By A. Press, B.Sc.

THE Marconi Wireless Telegraph Company of America on July 19, filed in the Court of Claims, a petition against the United States, charging that since June 25, 1910, the United States, through the



Marconi's Patent No. 763772 (1904) Purports to Cover Selective Tuning in a Rather Monopolistic Manner.

Army and Navy departments, and the Department of Commerce, has constructed and used apparatus embodying the inventions covered by four certain patents in violation of the rights of the Marconi Company.

The patents in question are as follows:

Re-Issue No. 11913 (Original No. 586193, July 13, 1897), granted to G. Marconi on June 4, 1901, for transmitting electrical impulses and signals and apparatus therefor.

No. 609154, granted to O. J. Lodge on August 16, 1898, for inventions in electric telegraphy.

No. 763772, granted to G. Marconi on June 28, 1904, for apparatus for wireless telegraphy.

No. 803684, granted to J. A. Fleming on November 7, 1905, for instrument for converting alternating electrical currents into continuous currents.

The petitioner avers among other things that the United States, through its officers or officials of its Department of the Navy, its Department of War, its Department of Commerce, knowing that the validity of said letters patent had been adjudicated in favor of your petitioner by several of the courts of the United States, has, since the twenty-fifth day of June, 1910, and before the filing of this petition, made and constructed, and used, a very large amount of apparatus containing and embodying in use the inventions covered and claimed in and by said letters patent of the United States; entered into agreements with divers persons and corporations, among such persons and corporations being, Fritz Lowenstein, Emil J. Simon, Telefunken Wireless Telegraph Company, Atlantic Communication Company, Kilbourne and Clark Company and Wireless Specialty Apparatus Company. The Marconi Company claims that this has resulted in great injury, damage and loss in the aggregate sum of $1,000,000.

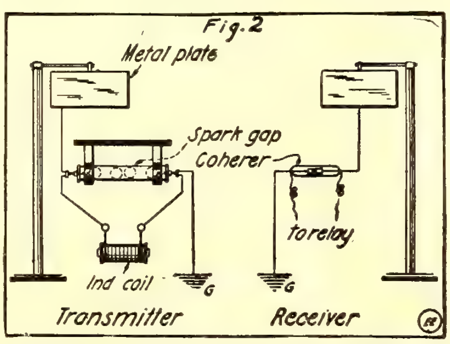
Turning to the particular patents in question it would appear that, the principal object of the Marconi invention cited in patent No. 763772 of 1904, appears to be to selectively syntonize a receiving station with a transmitting station. Strangely enough, one of the claims, claim 20, is of so indefinite a nature as to virtually control the broad idea of tuning a receiver circuit to be perfectly responsive to a transmitting circuit. It is a question whether a claim of such monopolistic scope can be maintained, because in the claim itself no particular means is set out whereby the well-known and desired object is to be attained.

From the fact that the patent discloses an adjustable reactance inserted in the antenna circuit, it follows that a certain degree of flexibility or adjustment is given to the system. The claims therefore are directed not only to the insertion of a reactance, whether variable or not, into the antenna circuit, but also to the possibility of attuning the practically closed oscillation circuit with the radiating or antenna circuit or with the transmission station. Their latter claims have certainly a much better chance of being maintained. The transmitter and receiving circuits are indicated at Fig. 1.

In the Marconi patent 11913, which is a reissue of the patent 586193 dated July 13, 1897, the invention goes back to the very early days when the earthed antenna terminal, both for sending and receiving was evolved. Acknowledgment is made of the work of Popoff in Russia, 1895-6, and of the writings of Sir Oliver J. Lodge in England, 1894.

In view of the disclaimer to claim 1, of the specification, it is difficult to see how claim 24 could be maintained, for in the text of the specification the making of the coherer tubes is acknowledged as well known and since reception of wireless waves by a filings coherer is also acknowledged to be old, a broad claim specifying nothing but the acknowledged elements of the art would seem to be in the same class with the disclaimed first claim which is of the same indefinite character.

The strong point about the above patent appears to be the reference to the earthed antenna circuit, though the claims are by no means as broad as would appear to be warranted. In the very early days of wireless the filing-tube-trembler element was

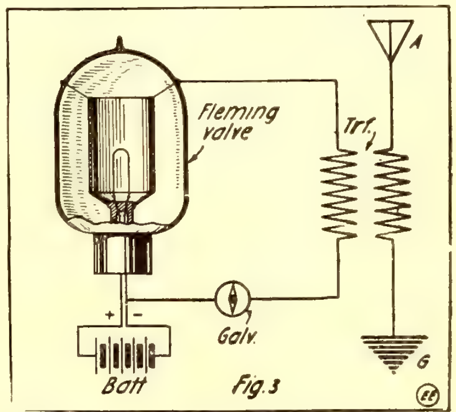


Marconi Patent No. 11913 (1901) Covers the Earth Connection and Other Features.

employed but this feature was soon discarded for other types of detectors. The appended Fig. 2 shows the essentials of the above features.

The Lodge patent 609154, dated August 16, 1898, seems to be directed particularly to the insertion of a variable reactance in the antenna circuit and also to the possibility of magnetically coupling the detector circuit to the antenna by means of a transformer.

Apparently the intention is to span the period from August 16, 1898, to date, by means of the patent as well as the later one issued to Marconi under No. 763772 as of date June 28, 1904. It is a little difficult to reconcile claim 7 of 763772 to Marconi with claim 1, for example, of 609154 of Lodge. Undoubtedly this matter would be taken up on its merits during the course of the suit, if it is the intention of the



The Famous Fleming Valve Patent, Which Appears to Cover Most Vacuum Tube Detectors of This General Type. See Recent Court Decision on This Patent, in the November Issue.

Marconi interests to sue on the basis of the above-referred-to claims.

With respect to the Fleming patent 803684 it is directed to the vacuum oscillation valve in which there is a rectification of current in precisely the same manner as in the important de Forest Audion valve. The fact that in any Audion type of valve three conductors are present or in fact n cessary for current amplification, cannot, in any manner, affect the validity of the claims.

It is rather strange that the claims in the Fleming patent, in the broader aspect, should require that there should be present a circuit connecting the heated electrode with another electrode led in to the vacuum chamber. In so far as a receiving station is concerned, the patent is limited to means for detecting a continuous current in the circuit. When a transformer is incorporated into the circuit for the detection of current, the claims appear to fail in outlining the necessary protection. The subjoined illustration, Fig. 3, shows one form of the Fleming oscillation valve rectifier.

PROPOSED WIRELESS STATION FOR SPAIN.

According to information recently published in the official organ of the Seville Chamber of Commerce, a company has been organized with a view to operating wireless telephone systems in the different cities of Spain and to connect with the Spanish vessels and Spanish colonies in Africa. The proposal contemplates the erection of stations in the cities of Cordoba, Seville, Cadiz and Huelva, and 29 other stations in other parts of Spain, in the Canary Islands, and at Tangier, Melilla, Ceuta, and Ibiza, in Africa. The first-class stations are to be of 5 kw. and the second of 2 kw. rating.

DONE.

"Well," said the doctor, "you're cured at last. How do you feel?"

"I feel," said the "radio op," looking at his wallet sadly. "I feel as if I could start life all over again."

The How and Why of Radio Apparatus

NO. 2—THE TRANSFORMER.

From time to time we will describe one particular instrument used in either the radio transmitting or receiving set, explaining just how it works, and why. We have received so many requests from new readers asking for such explanations, that we have decided to publish this matter in serial form. In the course of several issues all of the principal transmitting and receiving apparatus will have been covered. The subject for the second paper is the TRANSFORMER.

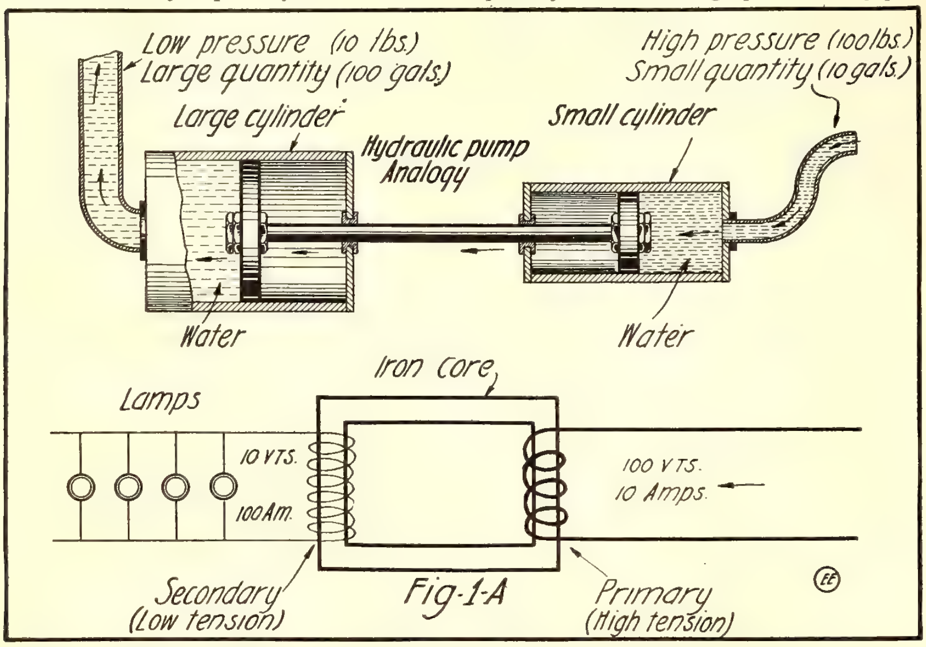


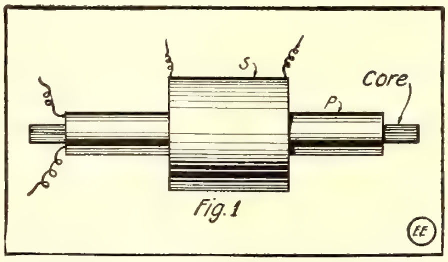
Fig. 1-A. Hydraulic Analogy of Transformer Action, Showing How Energy in One Form Can Be Changed Into Energy of Another Form.

THE first paper in this series dealt with the action taking place in the induction or spark coil as used for wireless and other purposes. In the present discussion we will consider the action occurring in that class of apparatus known as the alternating current *transformer.*

There are two distinct types of transformers, viz., the *open* and *closed core* type. The open or straight core transformer is shown schematically at Fig. 1 and the core consists of a laminated iron structure made of core wire or iron sheets, properly bound together with tape or placed in an insulating tube. Over this tube is wound the *primary* coil, consisting of two or more layers of relatively heavy insulated copper conductor. The *secondary* coil, wound in a number of small sections or in some cases on quite large spools, is then slipt over the primary, care being taken to thoroly insulate the two windings by placing the primary and core within a heavy walled insulating tube of hard rubber, or some other equally efficient insulator.

The closed core transformer, Fig. 2, has its magnetic circuit entirely closed and is therefore, as might well be imagined, the more efficient of the two. This is so for the reason that the magnetic flux produced by the primary coil P can complete its circuit entirely thru the laminated iron core which links the *secondary* winding *electromagnetically* with the *primary.* In the open core transformer, one end of the core is of a different magnetic polarity from the other and the magnetic flux has to thread its way from the *North* pole to the *South* pole, thru the air as shown in Fig. 3, and thus encounters an extremely high *reluctance,* as the term for magnetic resistance is known, thereby lowering the electrical efficiency considerably in this type of transformer.

Referring to Fig. 1A, which illustrates an hydraulic analogy of the alternating current transformer, it is seen how a small quantity of water at high pressure may perform work or transform its mechanical energy thru the medium of a double cylinder pump, resulting in the water issuing

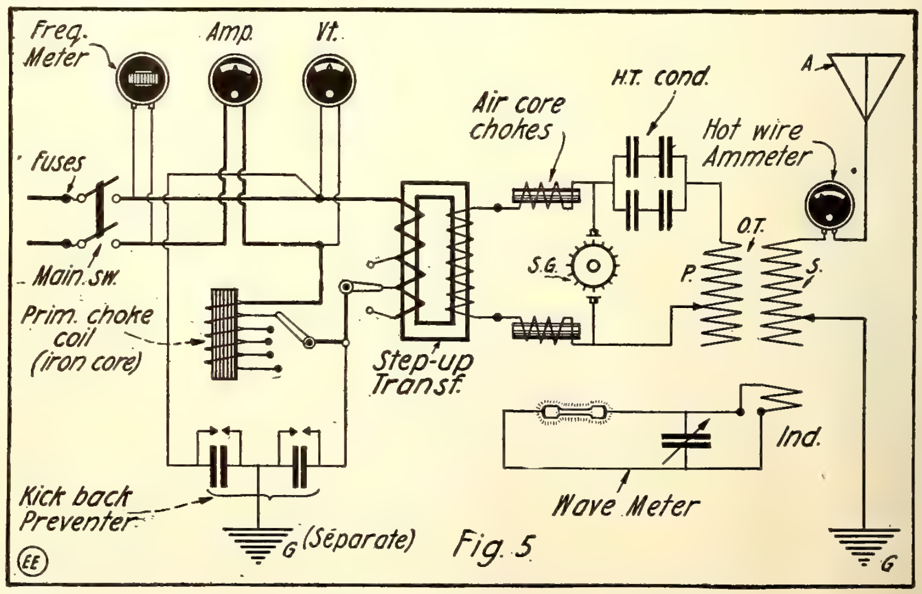


Principal Parts of an Open-Core Transformer; P—The Primary Coil and S—The Secondary.

from the large cylinder being expelled in a large quantity at low pressure. That is, suppose that the high pressure water stream enters the small cylinder at the right at a pressure of 100 pounds and with a quantity of 10 gallons. If this energy is utilized in pushing forward a piston connected to a steel rod and a large piston, in the cylinder at the left, fitted with a large efflux pipe, then the water in this cylinder will pass out in a large quantity, say 100 gallons at a low pressure, say 10 pounds. It is the same with the A.C. transformer. The primary winding corresponds to the small, high pressure water cylinder and may be supplied, for example, with a current of 10 amperes at a pressure of 100 volts. Considering that this transformer is of the step-down type, then the secondary (corresponding to the hydraulic analogy), may have a current of 100 amperes passing thru it at a pressure of 10 volts.

Generally speaking, the voltage ratio between the primary and secondary windings is directly dependent upon the ratio existing between the number of turns in the primary coil and those in the secondary coil, i.e., if there are 2,000 turns in the secondary and but 100 in the primary, then if the applied primary potential is 100 volts, the *induced* secondary potential will be twenty times this value, or 2,000 volts, for the reason that 2,000 divided by 100 gives twenty as the ***transformation ratio factor*** **for the** two windings. Conjointly, the secondary current in amperes will be reduced accordingly and inversely it will be, theoretically speaking, one-twentieth of the primary current in amperes. Thus we see that no transformer can produce more energy in its secondary circuit than that passing thru the primary circuit. Moreover, no transformer ever built will produce the current and voltage values in the secondary as just stated, as there is always some loss due to the transformation actions occurring within the transformer, which loss depends upon the size of the transformer and also whether it is of the closed or open core type.

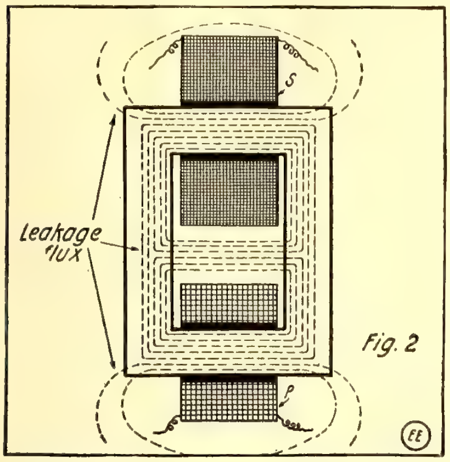
The usual efficiency figure for open core transformers is roughly 60%, but this of course will vary with the size and construction of the transformer. Closed core transformers realize as high as 85 and 90% overall efficiency, even in small sizes as low as 1 K.W. rating, and in large size commercial transformers used for lighting and power work, the net efficiency often reaches as high as 98% and more. This efficiency



Standard Wiring Diagram for Radio Transmitter, Comprising a Step-Up Transformer, Primary Choke Coil, Kick-Back Preventer, and Other Usual Apparatus.

expresses the relation between the net watts *primary input* and the net watts *secondary output.*

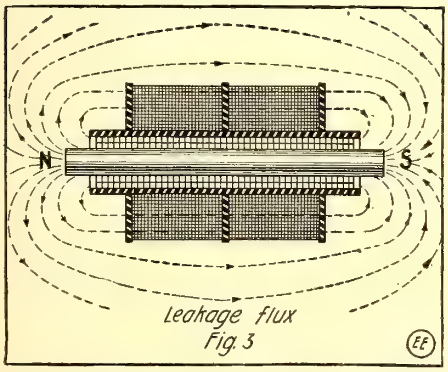
Thus, if a transformer is rated at 1 K.W. or 1,000 watts, it is usually understood that



Schematic Representation of Closed-Core Type Transformer, Showing Paths of Magnetic Flux and Leakage Lines. Efficiency 85 to 98 Per Cent, According to Size.

this is the secondary output, and if its gross efficiency was 94%, then the primary input would have to be 1063.83 watts and the difference between the two, 63.83 watts, would be that consumed by the iron and copper losses in the transformer.

Transformers operate in a manner analagous to the well-known induction or spark coil described in the First Paper of this series publisht in the November issue. The action in general is based on the fact that when an alternating current of any certain frequency is applied to the primary or exciting winding of the transformer, this will cause the iron core to become magnetized and demagnetized many times per second. This cycle of magnetization, first in one direction, then to zero and remagnetization in the opposite direction, occurs once for every cycle of the alternating current applied to the transformer; that is, if the primary current has a frequency of 60 cycles, then the magnetic flux set up will pass around the core first in one direction, and then in the opposite direction, at the rate of 120 times per second. As will become manifest, this will give rise to powerful induced currents in the adjoining secondary winding, which will have characteristics of a similar nature; that is, they will be currents similar in nature to those in the primary or alter-



General Appearance of the Magnetic Field About an Open-Core Transformer: Owing to Large Stray Field the Efficiency Is Low or in the Neighborhood of 60-65 Per Cent.

nating currents of like periodicity or frequency. The voltage or current may change, depending upon the design of the windings.

A great many people gain the idea that a transformer of the step-up or step-down type will change the frequency of an alternating current. But while this is so for certain peculiar arrangements of transformers and auxiliary coacting devices, this is not primarily so in the ordinary or garden variety of transformer generally found in experimental wireless and electrical laboratories.

The transformer, in the ordinary case, simply raises or lowers the applied primary potential or voltage with a consequent change in the current in amperes as previously explained.

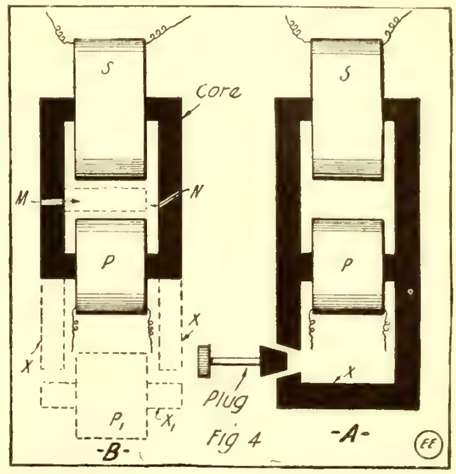
Transformers always draw a small current, even with the secondary open, which is required for magnetization of the iron core. A transformer is said to be operating on zero load when the secondary circuit is open. With this condition of no current in the secondary winding, there is a very small current in the primary winding for the following reason:* The current in the primary winding will cause an alternating magnetic field to be set up thru both the primary and the secondary windings, which induces an electromotive force in both of them. This induced E.M.F. is in the opposite direction to the E.M.F. imprest upon the primary winding and very nearly equal to it. It is only this difference in E.M.F. that is available for producing a current in the primary winding, and since this difference is small, there will be a small current in the primary winding when there is no load on the transformer. This current is called the *no-load current* of the transformer. The induced E.M.F. in the secondary coil is in phase with the E.M.F. induced in the primary, and it is in opposition to the imprest E.M.F. on the primary, or the primary and the secondary E.M.F.'s are displaced in phase by 180°.

Now if the secondary coil of a transformer be connected to a receiving circuit and delivering a current, the transformer is said to be *loaded.* Since the E.M.F. induced in the secondary coil is 180° from that imprest on the primary coil, the current in the secondary coil will produce a magnetizing effect which tends to lessen that produced by the small current already in the primary coil. Hence the variations in the magnetic flux passing thru both of the coils is decreased, which results in a decrease in the induced E.M.F. in the two coils. This decrease in counter E.M.F. in the primary coil results in an increase in the difference between the imprest E.M.F. and the counter E.M.F. which results in an increase of current in the primary coil. If the load on the secondary coil be increased or decreased there will be a proportional increase or decrease of current in the primary coil.

The relative primary and secondary actions occurring in the transformer are best shown by means of a clock or vector (geometric) diagram. In Fig. 6 the magnetic flux that passes thru both the primary and the secondary coils is represented by the vector (Φ), and the no-load current by the vector (I_o). The E.M.F. induced in the primary and the secondary coils will lag the magnetic flux (Φ) 90°.

The E.M.F. imprest upon the primary coil is utilized in overcoming the resistance of the coil, the counter E.M.F. induced in the coil by the flux (Φ), which passes thru both windings and the effect of magnetic leakage. The E.M.F., to overcome the resistance, is in phase with the primary current (Ip), as shown in the figure; the vector (Ep) represents the E.M.F. required to overcome that induced in the primary coil by the flux (Φ), and the vector (2πfLp Ip) represents the E.M.F. required to overcome the effect of magnetic leakage in the primary, which is 90° in advance of the primary current. The vector (Ep) represents the voltage imprest upon the primary coil.

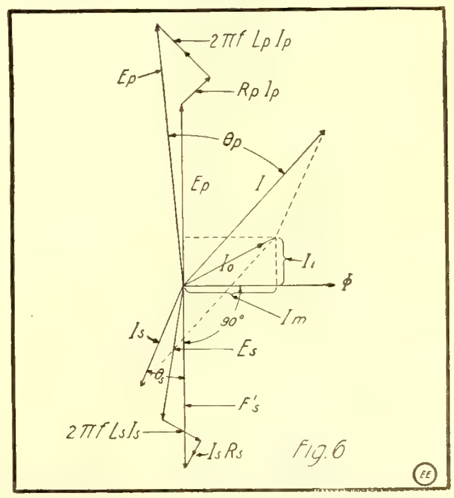
*See Practical Applied Electricity by D. P. Moreton for a more detailed discussion.



Showing Several Types of Radio Transformers Provided with "Magnetic Shunts" for Varying the Reactance (and Current) of the Primary Coil, and Consequently the Secondary Current Also.

The voltage induced in the secondary winding is represented by the vector (Es) which bears the same relation to the E.M.F. induced in the primary coil as exists between the primary and the secondary turns, which has been assumed as unity in this case. This vector represents the voltage at the terminals of the secondary coil when there is *no load* on the transformer. When the secondary coil is supplying a current, the terminal voltage drops on account of the (IsRs) drop and magnetic leakage. These drops must be subtracted from the total E.M.F. induced in the secondary coil, which gives the terminal voltage equal to (Es). The drop (RsIs) is parallel to (Is), and the drop (2πfLsIs) is perpendicular to (Is). If the secondary coil is supplying a current (Is) there will be a current in the primary coil, which combines with the no-load current (I_o), giving the true primary current (I). In this diagram θ=angle of lag or lead.

There have been a number of odd transformer designs brought out in the past few years and intended especially for radio work; one of the best of these is shown schematically at Fig. 4-A. This repre-



Vector Diagram which Shows Graphically the Phase (Lag or Lead) of Transformer Primary and Secondary Currents and Voltages.

sents the well-known Thordarson transformer, in which the primary, and consequently the secondary, current is controlled

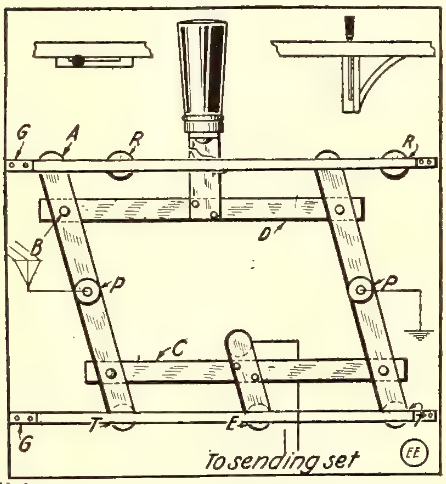
(*Continued on page 695*)

A CONCEALED TYPE ANTENNA SWITCH.

Practically all antenna switches which have been devised so far are designed to be secured at top of the instrument table or on the wall, and also they invariably do not present a very good appearance in combination with the rest of the apparatus.

To overcome this the design below is herewith suggested. It performs practically the same functions as most common antenna switches on the market and, as the sketch shows, it can be placed under the instrument table so that only the handle will protrude from the edge of the table in front of the operatoı, or it may be arranged for the handle to project from the top of the table. This makes a very neat arrangement indeed.

The details of the switch are very simple and, as seen, two metal blades "AA," made of brass or copper, are pivoted at "P." These blades are secured by rivets or screws at "B" to two fiber or hard rubber bars about 5 inches long, seen at "C" and "D." The lower fiber bar "C" carries a small stationary metal blade "E." In the position shown, this blade "E" closes a circuit between two switch buttons, which connect in series with the primary transmitting circuit of transformer. The aerial and ground connect with the pivot post "P," as observed; the receiving set connects



Unique Design of Antenna Switch Which Can Be Mounted Under the Table. Only the Handle Shows as Indicated in Upper Right Corner.

with the switch contacts "RR" and sending set with posts "TT." Two guide and tension strips "GG" serve to help line up the switch and give it a smoother action and also a better contact.

It is seen that this switch has a very simple motion, the handle always remaining vertical. A little oil on pivots will cause it to swing easily.

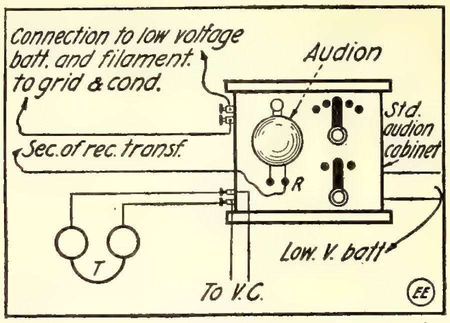
Contributed by E. L. H.

HOW TO MAKE ANY AUDION OSCILLATE.

An ideal oscillating Audion circuit must be one which is easily manipulated; it must be easily set oscillating; must require but little adjustment and should be suited to both damped and undamped waves, without any changes in the hook-up. Further it should require but little change from the ordinary Audion set and ought to work on short waves as well as long waves.

A circuit which fulfills the above requirements efficiently is herewith described.

In the ordinary Audion set there are two connections marked *tuner*. One of these leads to the grid condenser. The other is connected to the filament of the bulb. By opening the case the grid condenser binding post may be determined. One receiving transformer connection is made to this grid binding post. The second receiving transformer connection is joined to the plate, at the binding post marked "R" on the front of the Audion set. A variable condenser is



Scheme for Connecting Up Ordinary Audion so as to Oscillate. It Can Then Receive Undamped Wave Signals.

joined across the 'phones. No other changes in the circuit are required whatever.

The only additional instrument required over the ordinary amateur set is the variable capacity across the 'phones; this need be only of small capacity, say .0005 M.F.

To start this circuit oscillating, tune in any station and vary the capacity of the 'phone condenser. It is preferable to use quite loose coupling. After the bulb has been lighted for a few moments and is warm, with both aerial and secondary circuit in accurate resonance, it usually oscillates immediately if the proper 'phone capacity is determined. This is usually very little capacity. The fact that this circuit only operates when the primary and secondary circuits are in resonance is a great advantage, as there is no time wasted listening with the receiving set out of resonance.

To determine if the circuit is oscillating or not place the hand very near the secondary winding, and then draw it away; there will be a dull, *mushy* click, if it is oscillating properly.

When receiving undamped waves, the 'phone frequency can be varied to suit the operator by adjusting the shunt condenser across them.

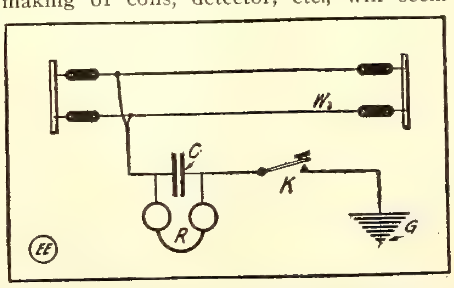
The author has obtained excellent success on 1,000 and 600 meter wave navy stations, which, although unreadable on the ordinary circuit, come in loud and strong. I have easily copied them on the typewriter as soon as the Audion oscillates.

Do not judge the circuit by the way it amplifies local signals. Listen in on your longest distance, weakest signal, and see what this circuit can do.

Contributed by EDGAR FELIX.

LEARNING THE CODE AT SLIGHT COST.

There are many boys who have visited wireless stations, and after *listening in* while the operator tuned in the various stations, have become fascinated enough to wish they were the possessors of a *set*. If they have never performed any electrical experiments, and especially if they are not of a mechanical turn of mind, the making of coils, detector, etc., will seem



Cheap Code Teaching Outfit Utilizing Induction Current on Aerial from Adjacent A. C. Circuit.

too difficult, and the fascination will soon disappear. If, however, they try the following simple experiment it will prove a stepping-stone to both the practice and theory of wireless.

Erect a small two or four-wire aerial adjacent and parallel to any alternating current circuit. If a high voltage is carried on these wires the aerial may be one hundred feet or even further away from them. In the country it is often possible to put up a low aerial on a fence near a power transmission line.

The only other things necessary are a telegraph key, a small condenser, and an ordinary 75-ohm telephone receiver. Any friend who understands something about electricity will show you how to insulate the aerial and how to follow the diagram of connections. The key and ground connection may be placed in a separate room. The condenser may be omitted, but doing so weakens the sound.

When the key is depressed, a note will be heard in the receiver, whose pitch depends on the frequency of the current. A sixty-cycle current gives a note slightly below "C" in the bass clef.

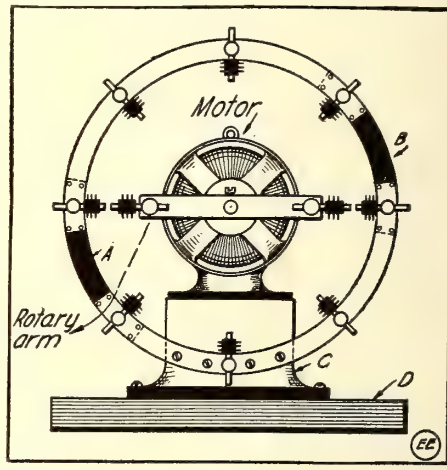
With this apparatus the wireless code may be practiced without the use of batteries, and what is more, it may be added to little by little until a complete wireless set is constructed.

The real foundation of wireless theory lies in *inductance and capacity*. With this simple outfit and a good text-book both of these subjects can be quickly understood.

Contributed by ROB TWEARL.

MARCONI TYPE ROTARY GAP.

The stationary ring A is a circle of edgewise-wound copper strip as used for mak-



Novel Form of Rotary Spark Gap for Experimenters. This Design Has Several Superior Features.

ing oscillation transformers, 7½ inches in diameter with eight binding posts mounted around at equal distances apart. On opposite sides the copper is cut away and replaced with Bakelite as A-B Fig. 1. The studs are made from a 3/16-inch round brass rod, cut in 2-inch lengths, threaded on one end half way. A nut is run on, then alternate thin copper washers ½"x¾" in diameter. C is a piece of ½-inch fiber to which the ring is bolted, and in turn fastened to the wood base D. The rotary member is a piece of flat brass strip 4 inches long, ⅝ inch wide, ¼ inch thick. In the exact center of one edge is drilled a hole the size of the motor shaft. A hole is also drilled and tapped for a set screw to hold the rotor on the shaft. The motor is bolted with machine screws to the base. If the rotor is not exactly in the center of the ring, the sparking-points can be adjusted.

Contributed by F. F. LAMBERT.

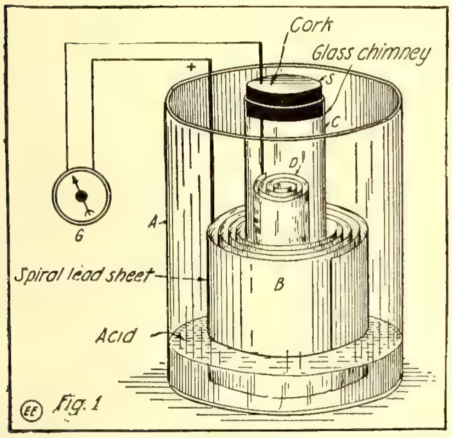
Tungsten contact points are being widely used in place of platinum ones on vibrators.

THE CONSTRUCTOR

Gas Batteries

By A. R. MacPherson

TO experimenters interested in electricity and chemistry there is a very fascinating and comparatively little workt field in the construction and operation of gas batteries. Altho little has been accom-

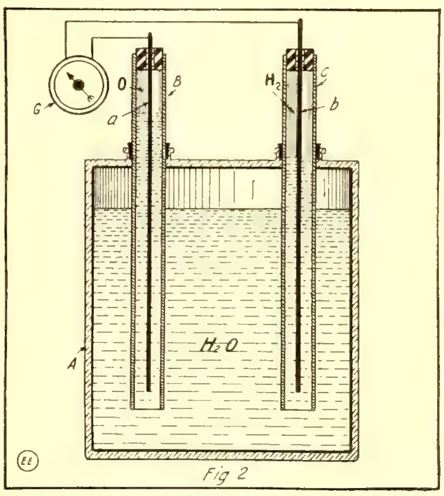


A Simple "Coal-Gas" Cell Which the Experimenter May Readily Construct and With Which He May Study the Mode of Action of Such Batteries.

plisht towards perfecting the gas battery as a commercial product, a patient research might reveal possibilities as yet undreamed of by scientists. When we consider the simple fact that a gas battery requires only two gases, one of which is highly electro-positive and one which is highly electro-negative, the solution of the problem then resolves itself into finding an economical chemical method of producing the two gases and causing them to combine. On consulting the table of chemical elements we find that hydrogen heads the list as being highly electro-positive, while oxygen concludes the list as being highly electro-negative. Thus with the most abundant elements of the earth, hydrogen and oxygen, it would seem very reasonable to take the oxygen from the air, and the hydrogen from the water, and produce a gas battery which would generate electricity on a commercial scale, and perhaps supersede the present methods of producing electricity.

A simple coal-gas cell may be constructed as shown in Fig. 1, which will give the experimenter an insight into the working principles employed in this form of battery. Procure a glass jar "A" of convenient size, and a thin sheet of lead "B", about 5 inches by 7 inches, which is bent in a spiral form to fit the inside of the jar. Then obtain a glass chimney "C", placing it inside the larger lead spiral, and fit a second spiral lead plate "D" into this smaller chimney. The two connections for the lead-out wires are taken off at the top of the lead electrodes as shown. To operate this cell pour a dilute sulfuric acid solution into the outer jar to a depth of two inches, and hold the glass chimney over a gas-jet until it is filled with gas. Then close it up with a tight fitting stopper "S", and replace it carefully in the large jar. Connect the terminals to a galvanometer "G", and the current will be indicated by the deflection of the needle. Thus we have a current set up with the production of water and carbon dioxide gas, one lead electrode being surrounded by air while the other is surrounded by the impure hydrogen in the coal-gas.

Another experimental cell of this type is shown in Fig 2, and is known as Grove's "Gas Battery." This consists of a double-neck bottle "A", with two glass tubes "B" and "C" passing thru stoppers in the neck. Inside of the two tubes are attached platinum electrodes or strips, a and b, which possess the property of occluding, or absorbing hydrogen and oxygen. To act as a gas battery this cell must first be charged with an electric current from an outside source, giving about three volts. During this charging process the weak acid solution in the bottle is decomposed, yielding hydrogen which collects in the tube "C," and oxygen which collects in the tube "B", at the rate of

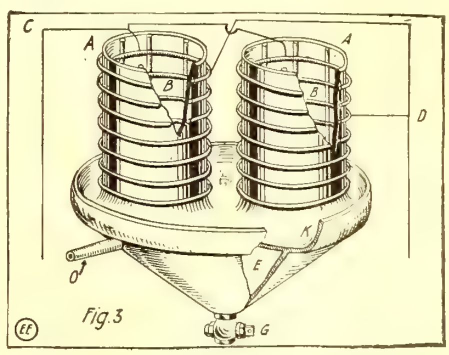


The "Grove" Gas Battery Comprising a Double-Neck Bottle with Two Glass Tubes Depending Downward, Inside Which Are Two Platinum Electrodes Immersed in a Weak Acid Solution.

two volumes of hydrogen to one of oxygen. When the tubes are filled with gas the wires are disconnected from the battery and attacht to the galvanometer "G." The gas battery will then be in action as indicated by the needle; water being again formed from combination of hydrogen and oxygen and an electric current generated. This cell illustrates both the storage and gas battery, as the electrical energy is first transformed into chemical potential energy in the form of the oxygen and hydrogen, and is then transformed into electrical energy again by the combination of hydrogen and oxygen to form water.

Another unique but complicated gas battery is that invented by A. Pletcher, a German scientist, and altho it is more of the ideal type of gas cell, it is impractical owing to the platinum used in its construction which renders it very expensive. Fig. 3 is a sectional view of this battery, which depends for its electrical action upon the combination of hydrogen and oxygen, brought about by the presence of finely divided platinum. It is constructed of a series of vessels "A", made from a mixture of clay with a platinum chlorid solution, which upon baking becomes hard, the platinum acquiring the finely divided condition. On the inside of the vessels is constructed a network of wires "B", fastened to the walls and connected to the one terminal "C". A similar system of wires is also built up on the exterior walls of the vessels and connected to the other terminal "D". Underneath the cells is a basin "E" with a pet-cock "G". The battery is operated by running a stream of hydrogen thru the opening "O" into the vessels, the oxygen being supplied by the surrounding atmosphere. Owing to the porous construction of the cells the two gases penetrate the walls and come under the influence of the platinum, which causes the oxygen and hydrogen to combine and form water with the production of an electric current. The water falls to the bottom of the basin "E", while that formed on the exterior walls is collected in the trough "K".

It is thus evident that the gas battery at the present time is in the experimental stage, serving only to illustrate the phenomenon of producing an electric current thru the combination of two gases. But there is every reason to believe that the ideal gas battery will soon be perfected, and man will have accomplisht the feat of harnessing that strange force known as chemical "affinity," and the transformation of the chemical energy of the atoms into the great electrical forces that will drive the machinery of the future. It has long been the dream of scientists to control the vast potential power that exists between the atoms and utilize it for commercial purposes, and with the perfection of the gas battery man will have realized another victory over the forces of nature.

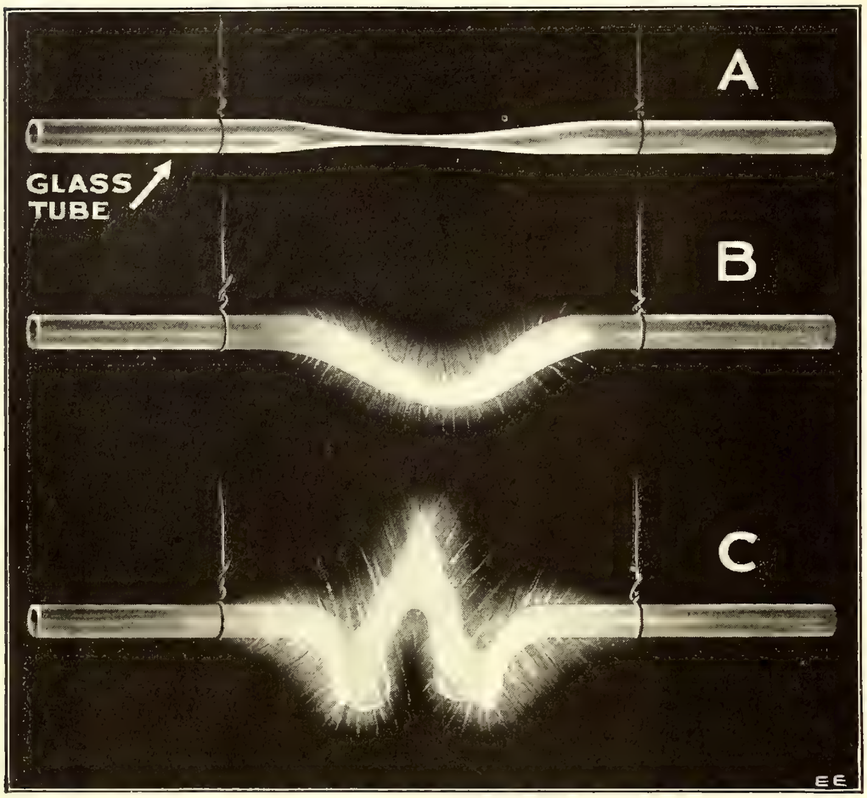


The Gas Battery Devised by A. Pletcher, Comprising Vessels Made of Clay Mixed with a Platinum Chlorid Solution. The Current Is Collected from Two Wire Networks on the Inner and Outer Surfaces of the Clay Vessels.

An Experimental Arc With Glass Electrodes

That glass, normally an excellent *insulator,* becomes a fair *conductor* when heated, has been mentioned in the July ELECTRICAL EXPERIMENTER.

A striking demonstration of this phenomenon is the production of a high-voltage arc between two glass electrodes.



Glass, Normally One of the Best of Insulators, Becomes a Conductor for Currents Having 2,000 Volts or More Potential, Under Certain Conditions, as Here Shown.

A transformer having a secondary voltage of 2,300 and a 1 k. w. rating is excellent for the purpose; a wireless transformer may be used if it is capable of furnishing 1/10 ampere secondary current.

Bare wire leads are joined to the secondary terminals of the transformer and twisted around a small glass tube about two inches apart. The tube must be quite small, not over ¼" diameter. If a larger tube is used it should be heated and drawn down to ⅛" or so as at sketch A.

Now turn on the primary current. Nothing happens; the glass insulates perfectly.

Then light a common match or candle and smoke the glass lightly. Be careful! The flame conducts! It is safer to cut off the primary current.

Now the film of soot conducts a current across, and rapidly heats up the glass. The soot burns off almost immediately, while the current continues to pass thru the glass, heating it to a bright yellow as at B. After half a minute the glass is quite soft and melts apart, leaving an air gap across which a broad yellow arc continues to pass, consuming the glass terminals rapidly, see C. Should the glass fail to melt apart, pull the tube in two by grasping the *cool* part, at a point at least three inches from the wire. Use one hand only.

That the current really *passes thru the glass* and not thru the *soot* may be proven by heating the glass with a soot-less blue flame, such as that of a Bunsen burner, blow torch or alcohol lamp. It is not necessary to bring the tube to a red heat if a large transformer is used, as the current will continue the heating effect.

If you still suspect that soot has something to do with the matter, you may do away with the flame by using a nail, driven thru a long stick to strike an arc between the wires, gradually leading the arc along the glass and heating it till the distance is short, so that the arc will hold. Then remove the nail and the arc, after sputtering a moment, will pass into the glass which, as before, is gradually heated to the melting point.

Contributed by S. KRUSE.

WHY GRAVITY BATTERIES FAIL TO WORK.

Many amateur electricians and some professionals experience considerable trouble with gravity batteries. They follow directions carefully and then fail to get good results. The usual trouble is not with the battery itself, but with the circuit. *A gravity battery is suitable only for a circuit which is normally closed.* It is, therefore, undesirable for operating electric bells, induction coils and all other open-circuit apparatus. The circuit should also have a high resistance. This makes it impractical for running fan motors, as the motor would have to be wound with fine wire and it would then require a large number of batteries to give a sufficiently high voltage.

The directions for setting up a gravity battery are as follows: Use about 3½ pounds of blue stone or enough to cover the copper element one inch. Pour in water sufficient to cover the zinc one-half inch. Short-circuit for three hours and the battery is ready for use. If desired for use immediately do not short-circuit, but add 5 or 6 oz. of zinc sulphate.

Keep the dividing line between the blue and white liquids about one-half inch below the bottom of the zinc. If too low, syphon off some of the white liquid and add the same amount of water, but do not agitate or mix the two solutions. Ordinarily this type of battery will give about .9 of a volt.

Contributed by KENNETH SWEZEY.

EMERGENCY "LEMON" BATTERY.

In an emergency it often happens that you need a small battery, especially in wireless work for operating detectors, 'phone tests, et cetera. To make such an emergency cell—copper, zinc, acid (citric acid)—proceed as follows:

Place one-half of a lemon in a cup, in a steady position. Cut one piece of zinc and one piece of copper, both of the same size and stick into the lemon, taking care, however, not to have the two touch each other in any way.

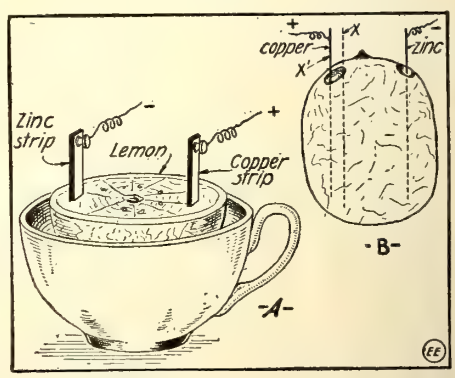
Connect the cell with wire and your battery is complete. By snapping the two ends of the wire together a tiny spark can be seen.

Contributed by HARRY DALALIAN.

[Editorial Note:—We were sufficiently interested in this "lemon" battery to try one. With two electrodes, one zinc and one copper, each 2¾ by ¼ by 1/32 inch, an E.M.F. (voltage) of 7/10 volt was obtained. The current was a fraction of an ampere, but gave good strong signals in a telephone receiver, sufficient for any testing work. The zinc plate acts as the positive electrode in the cell (— terminal) and the copper as the negative electrode (+terminal). When the external circuit is open no action ensues; when closed, citrate of zinc is formed at the zinc (+) electrode owing to the action of the citric acid. As the electrolyte is weak (about 5% citric acid, 95% water) no very powerful action takes place. Also the large amount of water, H_2O, present causes pronounced polarization, the hydrogen gas bubbles soon covering the copper (—) electrode, preventing further action if the cell is fairly well loaded. Unless some highly-oxidized substance is added to the electrolyte to produce oxygen, which combines with the hydrogen, forming water, therefore, the citric acid will become weakened by its action on the zinc, and the zinc will be consumed in time. The copper electrode is not attacked, except when some impurity exists in the electrolyte; citrate of copper was formed in minute quantities in one of the tests.

It is interesting to note that in a chemical test on 8,000 healthy lemons, there was produced 600 liters of juice, which tested from 4.5 to 6% citric acid (the balance mostly water). For rough testing the lemon may be cut in half as shown at A. Best results were obtained by simply cutting two ¼-inch holes at the top (see B), about 1" apart, the zinc and copper electrodes (well scraped) being inserted the full depth of the lemon in these holes. To reduce the internal resistance and to mitigate the loss due to the cellular suspension of the electrolyte, the two electrodes were placed about ¼ inch apart as at x_1, —x, with somewhat improved results. If the potential falls considerably, due to polarization, it was found that it could be temporarily restored by moving the copper plate up and down, or by removing it and wiping off the hydrogen gas film. A vinegar cell with zinc and copper electrodes is often used for test work. Here the zinc is converted into acetate of zinc and the copper (if attacked) into acetate of copper, as the solution is dilute acetic acid (with considerable water).—]

A higher voltage and less polarization can be had by substituting a lead pencil for the copper. The softer the lead, the smaller the polarization. The amperage with pencil lead (due to the smaller area) is somewhat smaller than if copper is used.



Even the "Lemon" Produces an Electric Current When a Copper and Zinc Strip Are Inserted in It, the Voltage Being About .7 Volt.

The Measurement of Capacity

MANY electrical and radio experimenters have but slight knowledge of the means used in measuring the capacity of electrical condensers. The general method, followed by the every-day experimenter is to employ some formula in which the physical dimensions of the various parts are substituted.

A common approximate formula for determining the capacity of any type condenser is:

$$C = \frac{2{,}248 \times K \times A}{d \times 10^{10}}$$

where C=Capacity in microfarads,
K=Inductivity of dielectric-taking air as unity, or 1,
A=Total active area of dielectric in square inches,
d=Thickness of dielectric in inches.

While this and other formulae hold good for general work, it is not accurate enough to determine the exact capacity; the only means of obtaining this is by actual measurement. It is the purpose of this article to explain two simple methods for measuring capacity so that the amateur can familiarize himself with them and make use of the methods here outlined.

A condenser of an unknown capacity can be readily measured by comparison with the known capacity of another condenser. This of course must be bought from a reliable company. In addition to this a *Ballistic* galvanometer, a double point key and a storage battery will be required. The connection for these instruments is shown in Fig. 1. The procedure is as follows:

The known capacity condenser is connected as shown and the key is closed (downward) so as to permit the current from the battery to charge the condenser *for 15 to 20 seconds.* The key is then released, thus discharging the condenser through the galvanometer, and in doing so a certain deflection will be noted on the scale. Several such operations are necessary before an average galvanometer reading is obtained. Having the average scale deflection of the condenser of known capacity, the unknown capacity condenser is substituted in the circuit where the first was connected. Several readings are taken just as with the condenser of known capacity.

The quantity of electricity stored in a condenser varies directly with its size. Therefore, the capacities of the two condensers are to each other as the deflections of the galvanometer. Consequently the expression for determining the capacity by the above method is:

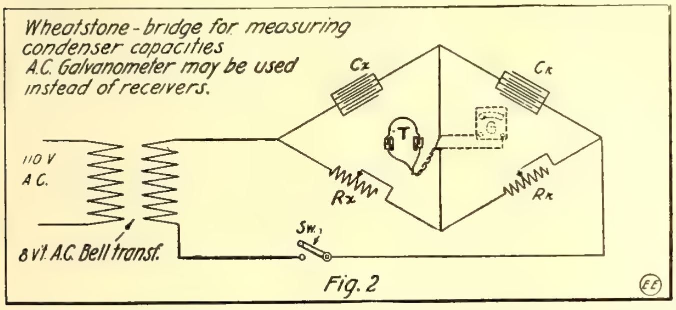
$$\frac{D}{D_1} = \frac{Ck}{Cx}$$

where:
D=deflection obtained with condenser of known capacity,
D_1=deflection obtained with condenser of unknown capacity,
Ck=known capacity,
and Cx=unknown capacity,

Solving the above equation, we get:

$$Cx = \frac{CkD_1}{D}$$

A second method of measuring capacity is that employing an ordinary Wheatstone bridge. The arrangement of connections is given in Fig. 2, where Ck is the known capacity and Cx the unknown. They are placed on both arms of the bridge while the other two arms are composed of two known resistances, Rk and Rx. The current is obtained from a step-down transformer connected to 110 volts, alternating current supply, or it can be an ordinary hand-driven telephone magneto. The current feeds are shunted across the arms and a switch interposed. A telephone receiver is substituted for the galvanometer shown in dotted lines. When a battery is used a sensitive galvanometer can be utilized.



How a Special Type of Wheatstone Bridge Is Used to Measure Condenser Capacity. A Galvanometer "G" Is Utilized when Battery Current Only Is Available.

The operation is as follows: The current is sent through the bridge and both resistances Rx and Rk are adjusted until practically no hum is heard in the telephone receiver (or no deflection on galvanometer) and the values of the three known factors are given in the following equation:

$$Cx = \frac{Rk \times Ck}{Rx}$$

where: Cx=capacity of unknown condenser
Ck=capacity of known condenser
Rk=resistance of one arm
Rx=resistance of second arm

In using the above method it should be remembered that the resistances of the bridge *must be wound non-inductively.* The unit of capacity of the unknown will be the same as the standard condenser. Thus if the known condenser has a capacity of 02 microfarads, the unit of the unknown condenser capacity will be in microfarads.

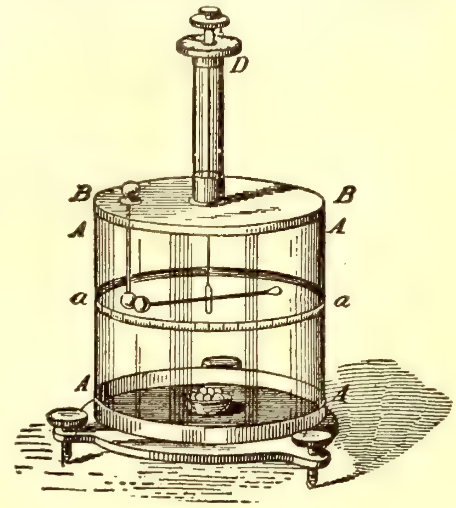
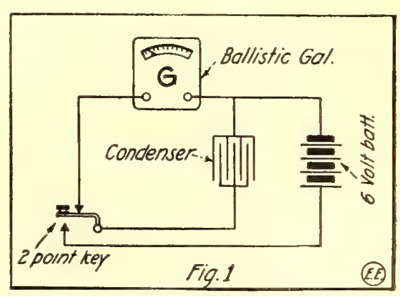


Fig. 3. The Ballistic Galvanometer Having Low Damping (Slow Swing) Used in Determining Condenser Capacity as Shown in Fig. 1.

An explanation of the construction of a Ballistic galvanometer as used in the electrostatic measurements will not be amiss here, as the majority of experimenters are unfamiliar with this instrument, though many would doubtless like to build one.

The Ballistic galvanometer is nothing more than an ordinary Coulomb's torsion balance as will be seen from Fig. 3. This consists of a light metallic rod with small brass balls a, a, on each end and supported by a fine metal wire, the torsion constant of which is known. The connections to the stationary electrode are made through B, while the movable one is connected through D. An adjusting knob is placed on top for resetting the movable rod. The parts are enclosed in a sealed glass case A, and a quantity of calcium chloride is placed at the bottom for absorbing any moisture that may be in the vessel.

When an electrostatic current is sent through the stationary and movable electrode, a certain amount of attraction or repulsion will result between the balls, depending upon the polarity in which they are charged, due to the electric charge between the balls. The amount of swing of the movable electrode is proportional to the quantity of electricity acting between them. The scale on the circumference of the glass vessel is marked in degrees and indicates the position of the movable electrode when a current is passed through.



Comparison Method of Checking Up Condenser Capacity, Utilizing a Ballistic Galvanometer for the Purpose.

This instrument is very easily made and if constructed correctly, it will find a valuable place in the laboratory of many experimenters.

SOLDERING WRINKLES.

Following are several hints on solders and soldering fluxes. A Valuable Soldering Liquid: Cut zinc into small pieces, dissolve in hydrochloric acid, add one-fourth part of the solution of ammonia and dilute with water. Dissolve in twelve parts of water one and one-half parts of glycerine and one and one-half parts lactic acid.

Soldering Paste: Make a syrup of starch paste with a solution of chloride of tin.

Fluxes for Welding: A secret well worth knowing is as follows: Take 6 ounces of common salt, 1 ounce of black oxide of manganese, 2 ounces of copperas, 1 ounce of saltpeter, 1 ounce of prussiate of potash; pulverize and mix with 3 pounds of welding sand.

Solders—How They Are Made. Soft spelter is made of 1 part copper, 1 part zinc; hard spelter, 2 parts copper, 1 of zinc; plumbers' coarse solder, 1 part tin, 3 lead; plumbers' seal solder, tin 1, lead 2; tinners' solder, tin 1½, lead 1; hard solder for copper, brass and iron, copper 2, zinc 1; silver solder for jewelers, silver 19, copper 1, brass 1; silver solder for plating, silver 2, brass 1; silver for silver, brass and iron, silver 1, brass 1; gold solder, gold 12, silver 2, copper 4; bismuth solder, lead 4, tin 4, bismuth 1.

Contributed by
EDW. C. CONNELLY.

This department will award the following monthly prizes: **First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.**

The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of **$3.00** is awarded; for the second best idea a **$2.00** prize, and for the third best a prize of **$1.00**. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

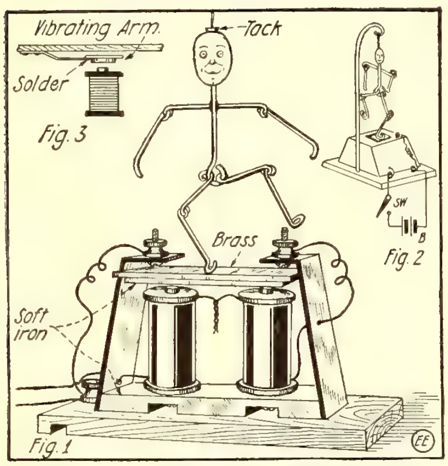
FIRST PRIZE, $3.00

AN ELECTRIC DANCING TOY.

Here is an electrical toy that will provide plenty of amusement, especially to the younger members of the family, and is well worth the time and trouble necessary to construct it.

The materials required consist chiefly of the remnants of a discarded battery bell, a few binding posts and screws and several pieces of aluminum or other wire.

The stand or base should be made first and may be of any size or shape according to one's taste. The top piece, however, must have holes for two binding screws and an opening, Fig. 2, so as to allow the feet of the dancing figure to rest on the vibrator. This latter, Fig. 3, consists of a brass piece with an under soft iron bar extending crosswise and soldered or fastened in some other convenient method to a brass strip, having tension enough to keep it forced upwards under normal conditions against two binding set screws, which act as contacts. The electro-magnets should be fastened directly under the soft iron bar of the armature, or vibrator, and



A Magnetically Operated Dancing Man which Can Be Made from Odd Parts.

the wire connections made as shown.

The dancing figure itself is very easily and quickly constructed. About eight pieces of ordinary battery wire, cut into about equal lengths, should be bent at the ends by means of pliers in a manner similar to Fig. 1, so as to allow freedom of motion. A hickory nut or a small wooden ball decorated with a few artistic touches of white paint and then placed on the upper end of the main wire will make the figure more realistic and ludicrous. When completed, hang by means of a string to a rod as illustrated in Fig. 2, which is inserted into a hole in the base of the toy.

Now that the toy is constructed, it may be well to know how it is to work. In the first place when we close the switch of the battery circuit, the current travels from the lower left hand binding screw to the upper one, thence via the armature to the right hand screw and through the magnets, thereby energizing them and causing the armature to be attracted downward, which action breaks the circuit. This alternate making and breaking being continuous, the armature rapidly vibrates and as the feet of the figure come in contact, the same motion is imparted to it.

Contributed by JOHN T. DWYER.

SECOND PRIZE, $2.00

EXTENSION PLUG MADE FROM "BLOWN" FUSE.

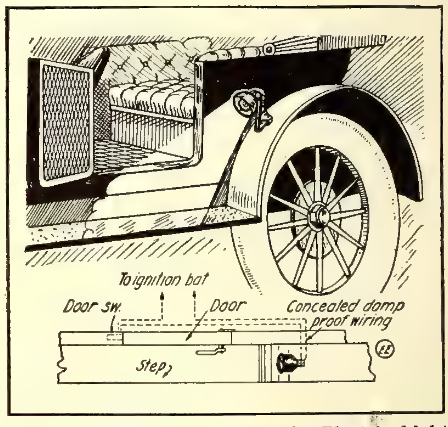
The accompanying illustration shows an extension plug which works to good advantage. As will readily be seen it is made from a burned out fuse plug. Having taken off the brass ring on the top and removed the mica disc, I shortened the broken fuse wire, soldered the lamp cord terminals to each end of the fuse wire, and punched two holes in the mica to keep the wires separated. Then I replaced mica disc and brass ring and connected the cord to a regular lamp socket. This home-made attachment plug can be used anywhere as it fits any socket.

Contributed by
GEO. M. VARETH.

THIRD PRIZE, $1.00

AUTOMOBILE STEP LIGHT.

How many times have you mist your step when entering your automobile at night? All owners of motor cars can obviate this inconvenience by installing or having installed a small battery lamp and reflector in line with the step of the auto, as the illustration indicates. The circuit of the lamp is controlled automatically by a spring switch, such as used for installation on burglar alarms circuits. This door-actuated switch may be purchased of any electrical supply house and should be mortised in the door frame on the car so it will look as neat as possible. Any garage



When the Auto Door Opens the Electric Light Illuminates the Step. Closing the Door Extinguishes It.

can install such a light together with suitable water-proof wiring and it can be supplied with current from the ignition battery of the car.

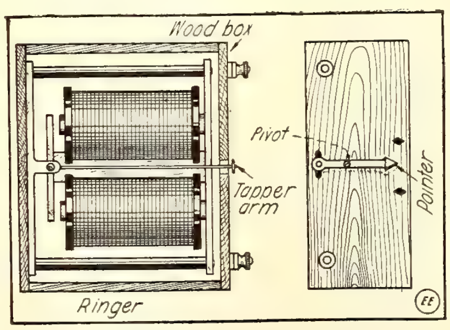
Contributed by
ANDREW L. GALLAGHER.

A POLARIZED POLARITY INDICATOR.

A simple polarity indicator that can be used on any voltage up to 110 may be made from an ordinary polarized bell ringer and a small wooden box. Mount the ringer inside the box with the tapper extending through a small hole at one end of the box, as shown.

From a piece of tin cut a small pointer 1½ inches long. The center of this pointer is pivoted to the top end of the box, and the tapper arm inserted in a hole at the end of the needle.

Two binding-posts are mounted on the box at the lower edge. These posts should be wired to the ringer so that the pointer



Useful Polarity Indicator Constructed from Polarized Telephone Ringer.

will swing to the post which has a positive wire connected to it.

This can be tested by using an ordinary dry cell and changing the wires until the pointer swings to the binding-post which has the wire from the carbon of the cell connected to it.

This instrument may be mounted on a laboratory switchboard and will be found very useful to experimenters who frequently desire to test the polarity of wires without the trouble of tracing out the connections.

Contributed by A. T. LYNCH.

MAKING BLACK MARKS ON GRADUATED SURFACES.

The scale is varnished over with a little thin shellac varnish, so as to sink into all the cuts. When dry, a black varnish of lampblack and shellac is spread on, so as to fill all the cuts and this is allowed to thoroly dry. When hard the work is driven in a lathe, and the superfluous varnish polished off with fine flour emery cloth until only that in the cuts is left. This gives a very distinct marking and fine finish to scale.

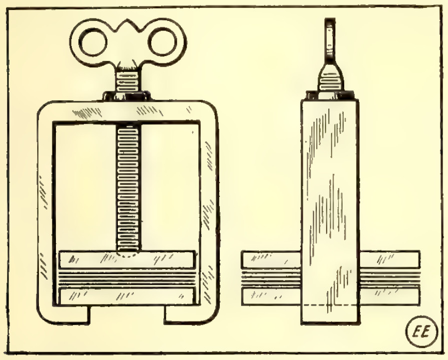
Don't fail to read the intensely interesting new serial "Experimental Physics" starting in the next issue.

LAMINATED SWITCH CONTACTS.

I wanted to use a copper plate about 1/8" thick for a fan switch but had nothing on hand but some sheet copper 1/32" thick, which was too limber. I cut some pieces the required size and covered both sides of all but two strips with solder.

Then put the pile of strips between two smooth flat iron strips and insert the whole in a clamp.

This is to be placed in a fire so as to melt the solder. As the solder melts tighten



Solid Copper Bars or Contacts Can Be Made by Clamping Several Thin Sheets Together and Sweating Them with Solder.

the screw. When all the solder is melted take it out of the fire and let it cool before loosening the screw. This is almost as good for some purposes as a solid piece.

The illustration shows the kind of a clamp that I used and is easily made.

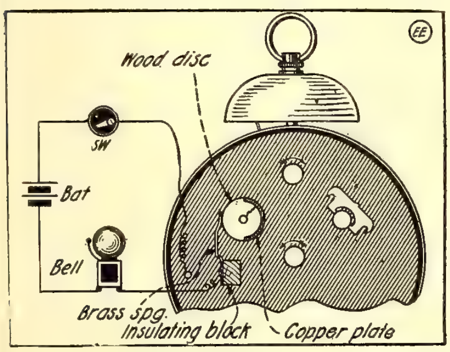
Contributed by WALTER R. BENNETT.

AN ELECTRIC ALARM CLOCK WRINKLE.

From reading current publications it would appear that the amateur electrician has overtaxed his ingenuity in devising attachments for alarm clocks to ring an electric bell.

Most of those described, however, have been more or less makeshifts, unsightly or unreliable. The writer therefore believes that the device used by himself for over a year with excellent results will be of interest to those who use this type of alarm.

It was constructed by mounting a disc of wood ½ inch in diameter on the winding spindle of the alarm. One-half of the circumference of this disc was covered with copper sheeting electrically connected



Novel Electric Circuit Closer for Attachment on Alarm Clocks.

to the spindle by a short length of copper wire.

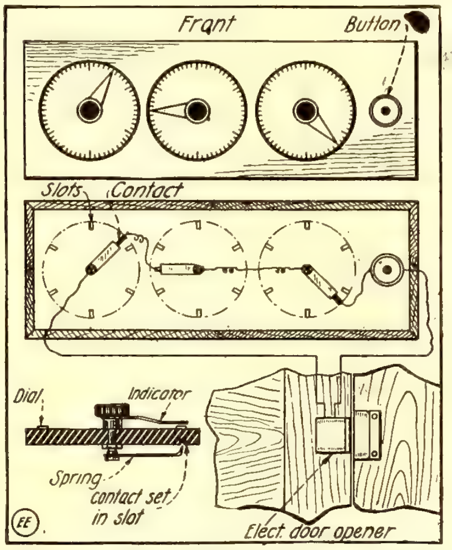
A brass spring supported by an insulating block as shown in the illustration presses against the face of the wood disc. The connections of this device are shown in the illustration. The operation of the alarm will be easily understood since the disc, as it revolves with the spindle, alternately opens and closes the bell circuit. The regular tapper on the alarm clock may be broken off or bent in such a manner as to prevent it from ringing.

This attachment does not mar the appearance of the clock or require resetting beyond making sure that the brass spring normally rests on the wood disc and not touching the copper plate.

Contributed by A. T. LYNCH.

THAT ELECTRIC "COMBINATION" LOCK.

To open the combination lock shown in the March ELECTRICAL EXPERIMENTER simply allow the contact switch to remain on any one of the points and, using a piece of bare copper wire, wind it around the contact points. Repeat the same process with the other two switches; press the button and Presto, the lock releases. In the improved design of a similar lock, illustrated here, it is quite impossible for anyone to



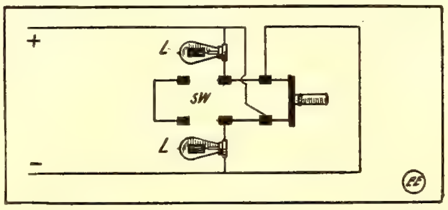
A Better Solution of the Electric "Combination" Lock Idea Recently Published on this Page. The Contacts Are Concealed in this Design.

thus short-circuit the live parts. In the rear view of the lock, the small piece to which the arrow points is the contact or switch point. The contact spring is set properly for the lock to be opened. The contact point should be of brass ½"x⅛" and ⅛" thick. This should then be firmly imbedded in the wood next to the number you have chosen. (Before doing this solder a foot or so of flexible wire to the piece of brass.)

Contributed by HYMAN JACOBSON.

SWITCHING TWO LAMPS FROM SERIES TO PARALLEL.

In your July, 1916, issue, an "Interesting Hook-up Explained" gives a method for changing two lamps from series to parallel connections by means of an ordinary, double-pole, double-throw knife switch. Here is a simpler arrangement for the same purpose and this connection has some advantages over the former one. In this case the terminals of neither lamp are reversed, as the switch is thrown from one side to the other. The connection may therefore



Good Switching Scheme to Connect Two Lamps in Series or Parallel.

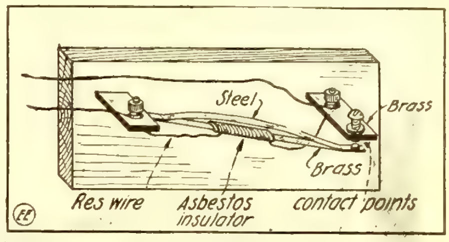
be used for two batteries or two single cells, to double the voltage when the switch is closed to the left; and to halve the voltage when thrown from left to right.

Contributed by B. B. BRACKETT.

A THERMO FLASHER FOR LAMP CIRCUITS.

A thermo flasher for battery lamp circuits is easily made as shown in the illustration.

The base is of hard rubber or fibre; the standards are of brass, screwed to the base through binding posts. The lever is a piece of steel and brass. Pro-



The Electric Current Passes Thru the Coil, Heating the Strip, Causing it to Bend Upward and Close the Circuit. It then Cools and Opens the Circuit, etc.

cure a small piece of asbestos paper, place it on the brass strip and wind a few turns of No. 26 B. & S. gage resistance wire over it. I think the drawings will enable the reader to gain a clear idea of the device.

Contributed by OTTO CLAWSON.

TO BORE A HOLE IN HARDENED STEEL.

Melt a small quantity of wax and pour it on to the steel. Make a hole in the wax of the dimensions desired.

Then put a few drops of nitric acid in the hole and leave it for some time. If not eaten through in 15 or 20 minutes wash the acid off and apply another dose. Continue this until the hole is eaten through.

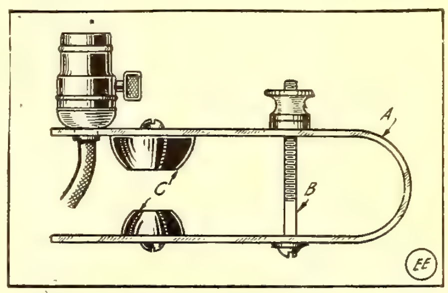
Non-rusting soldering fluid:—While the zinc chloride soldering flux works nicely on steel, so far as soldering goes, it should not be used where there is danger of rust. A solution that will not cause rust, is made by mixing

6 oz. alcohol
2 oz. glycerine
1 oz. oxide of zinc

Contributed by LOUIS WILLIAMS.

A HANDY CLAMP FOR INCANDESCENT LAMPS

In the accompanying sketch there is shown a very serviceable adjustment clamp for the purpose of securing the incandescent lamp to any part of a machine or other fixture. The clamp consists of a piece of



Useful Clamp Enabling One to Fasten Lamp at any Point Desired.

metal about 1/16" thick by 1" wide, as indicated at A. A long No. 8-32 machine screw with thumb nut is placed as shown, so that the clamp may be compressed as desired to lock it in any desired position. Two fibre or soft rubber (gasket) pads C, are riveted or screwed to the clamp A, so as not to mar the furniture on which the lamp is placed and also to provide a better grip. A piece of flexible lamp cord leads to the key socket, and this is provided with a standard attachment plug at its free end.

Contributed by FOREST B. TURNER.

"ELECTRO" WIR

New York City, N. Y., December, 1916.

MR. WIRELESS AMATEUR,
Anywhere, U. S. A.

My Dear Sir:—Perhaps you have heard of the Electro Importing Co. before. Perhaps you are one of the countless satisfied users of E. I. Co. apparatus. But do you know these FACTS which can be readily proved by anyone?

The E. I. Co. is the oldest electrical experimental supply house in the world. Established in 1904—13 years old. The E. I. Co. controls more wireless and kindred patents than any other similar establishment in the United States. The company controls ALL the patents of the undersigned, manufacturing and selling all apparatus under these patents.

The E. I. Co. today probably does the largest volume of business in Radio and Experimental Apparatus in the United States. The E. I. Co. ALWAYS has blazed the way—WE LEAD, OTHERS FOLLOW. This advertisement—the greatest wireless announcement of the year—proves it amply.

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The E. I. Co. has issued its new Catalog No. 18 containing a wealth of new articles and information. The free coupon brings it.

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Our **"Government" Receivers** have for years been a standard for all to look up to. They have aluminum shells, perfect diaphragms, 5 ft. silk cord and are now supplied with the wonderful "Gernsback Adjustable" Headband. Shipping weight, 3 lbs.

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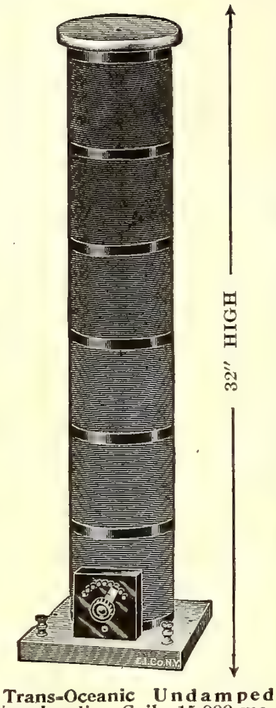
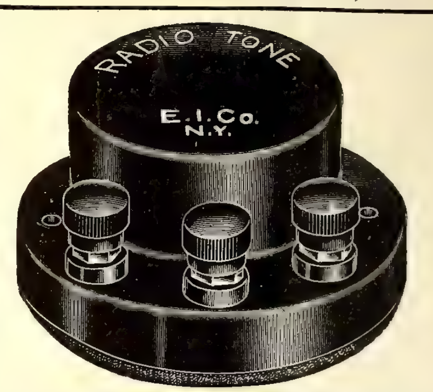


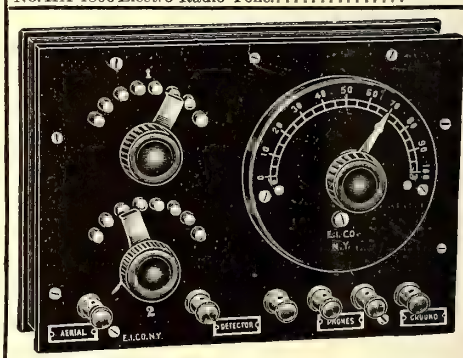
Trans-Oceanic Undamped Wave Loading Coil—15,000 meters **capacity**. The biggest and best coil of its kind ever developed. Note the size, 32x8x8 in. Wound with green silk wire on special tubes. Frame of hand-rubbed **mahogany**. Metal nickel plated. Switch Navy type. Value twice what we ask. Shipping weight, 5 lbs.

No. HEK-4500 Trans-Oceanic Undamped Wave Loading Coil **$8.50**



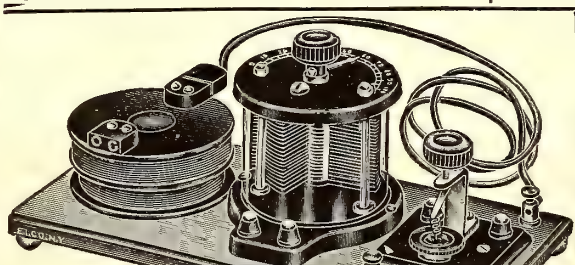
The Electro Radio Tone. The newest thing in wireless. A perfect test buzzer at last. Has rubber composition case, **is absolutely noiseless,** gives a beautiful high pitched musical note and can't get out of adjustment. Our catalog shows several new uses for this instrument. As always, it is the best on the market. Shipping weight, 4 oz. **Ready for delivery January 15th, 1917.**

No. HX-1800 Electro Radio Tone **$0.80**



Arlington (NAA) Baby Timer. 1200 meters wavelength. All that its name implies and more. Receives long waves perfectly. Has **Bakelite** front and hand-rubbed **mahogany** case. All metal nickel plated and polished. Size, 3¾x6x2.

No. HEK-4433 Arlington (NAA) Baby Timer (no phones). Weight, 4 lbs. **$8.50**



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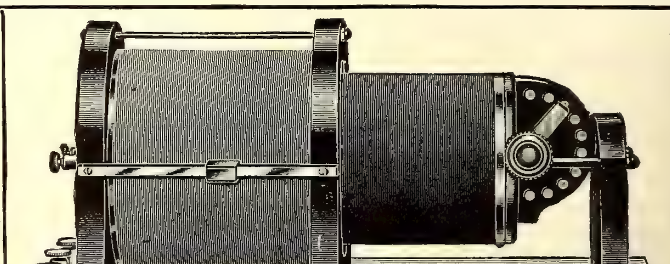

Professional Loose Coupler. The 1917 model of the best coupler on the market at its price. Note the size, 15½x7½x7¼. Tunes up to 3000 meters easily. Navy type switch on secondary with 10 points. Shipping weight, 10 lbs.

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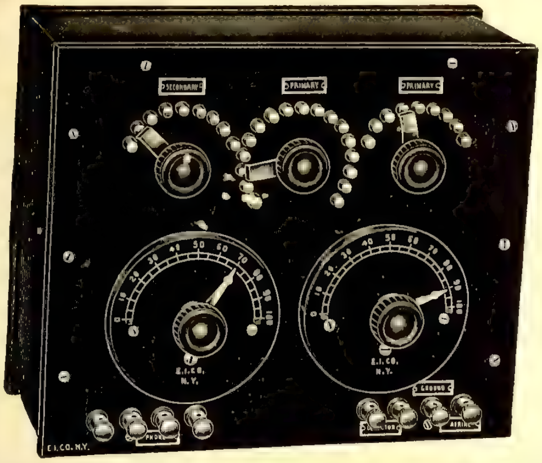
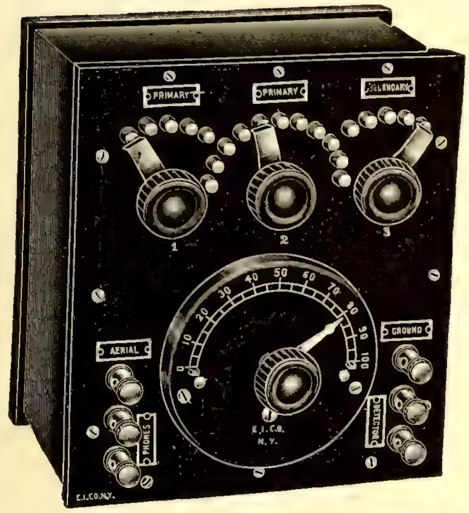
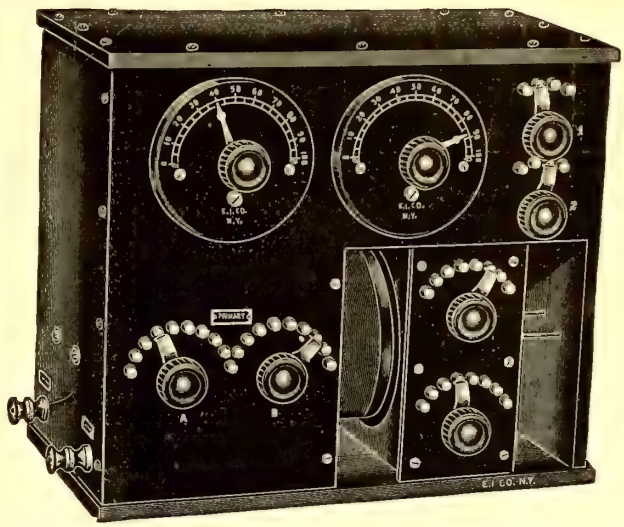
LESS NEWS



Sayville (WSL) Radio Outfit. 2500 meters wavelength. A de luxe cabinet that is compact, efficient, good looking and yet is not expensive. All tuning is by switches, and the front is of **Bakelite**, the metal highly nickeled and the case is of hand-rubbed **mahogany**. Size, 12x10x5½. Shipping weight, 9 lbs. **$18.00**
No. AHX-4455 Sayville (WSL) Radio Outfit (no phones)



Key West (NAR) Radio Outfit. 2000 meters wavelength. Combines more value in a small outfit than any outfit we make. Has made some wonderful long records in tests. **Bakelite** front, nickeled metal, and hand-rubbed **mahogany** case. Size, 8x8x4½. Shipping weight, 6 lbs.
No. ADX-4444 Key West (NAR) Radio Outfit (no phones) **$14.00**



Nauen (POZ) Radio Outfit. 3500 meters wavelength. Made to do just what its name implies, to receive European messages, **and does it.** Has a remarkable Navy type receiving transformer and condensers. Entire front of **Bakelite**, metal highly nickeled and case, size 17½x11½x7, is of hand-rubbed **mahogany**. A perfect instrument at a very reasonable price. Receives up to 3500 meters without extra coils. A real bargain.
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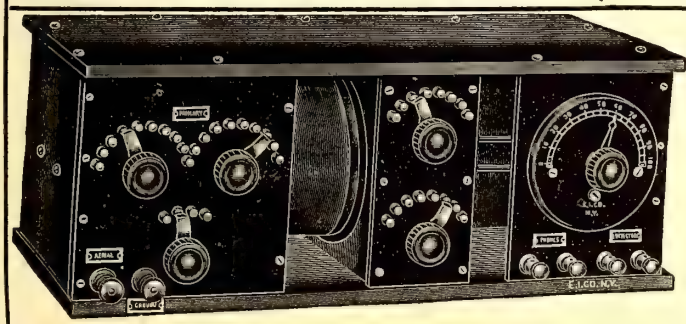

Tuckerton (WGG) Radio Outfit. Receives long and short waves in great style. Has the most wonderful Navy type loose coupler you have ever seen. All fronts of **Bakelite**, metal nickeled and case of hand-rubbed **mahogany**. Size, 21½x7x6¾ in. Shipping wt., 15 lbs. **$26.00**
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FULTON ST., NEW YORK, N. Y.

"ELECTRO" WIRLESS NEWS

New York City, N. Y., December, 1916.

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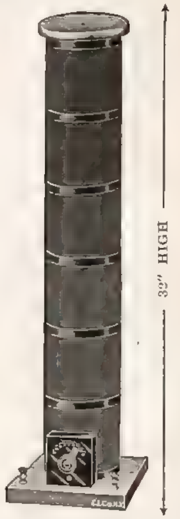
Our "Government" Receivers have for years been a standard for all to look up to. They have aluminum shells, perfect diaphragms, 5 ft. silk cord and are now supplied with the wonderful "Gernsback Adjustable" Headband. Shipping weight, 3 lbs.

No. GX—6666 "Government" Wireless Receivers .. **$7.00**

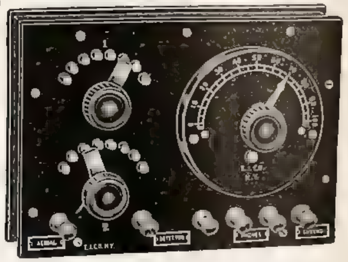


Trans-Oceanic Undamped Wave Loading Coil—15,000 meters capacity. The biggest and best coil of its kind ever developed. Note the size 32x8x8 in. Wound with green silk wire on special tubes. Frame of hand-rubbed **mahogany**. Metal nickel plated. Switch Navy type. Value twice what we ask. Shipping weight, 5 lbs.

No. HEK-4500 Trans-Oceanic Undamped Wave Loading Coil....... **$8.50**

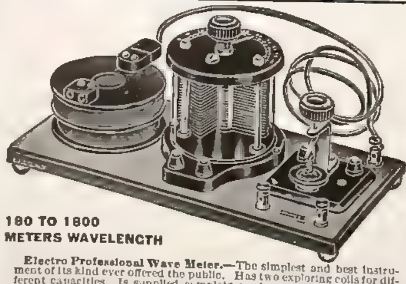
The Electro Radio Tone. The newest thing in wireless. A perfect test buzzer at last. Has rubber composition case, **is absolutely noiseless,** gives a beautiful high pitched musical note and can't get out of adjustment. Our catalog shows several new uses for this instrument. As always, it is the best on the market. Shipping weight, 4 oz. **Ready for delivery January 15th, 1917.**

No. HX-1800 Electro Radio Tone . . **$0.80**



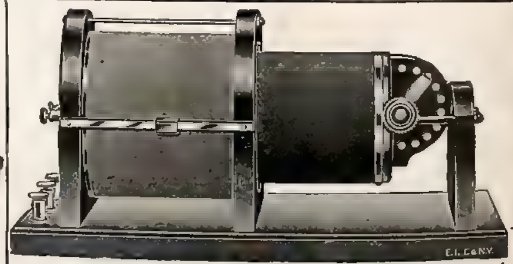
Arlington (NAA) Baby Timer. 1200 meters wavelength. All that its name implies and more. Receives long waves perfectly. **Has Bakelite** front and hand-rubbed **mahogany** case. All metal nickel plated and polished. Size, $3\frac{1}{4}$x6x2.

No. HEK-4433 Arlington (NAA) Baby Timer (no phones). Weight, 4 lbs.................... **$8.50**



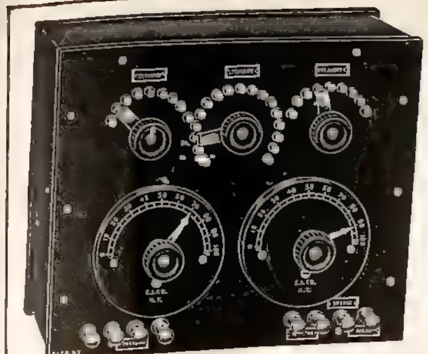
Electro Professional Wave Meter.—The simplest and best instrument of its kind ever offered the public. Has two exploring coils for different capacities. Is supplied complete as shown with full directions and calibration curves. Woodwork hand-rubbed mahogany. Shipping weight, 10 lbs. Reads from 180 to 1800 meters. Accurate to within 3%. Ready for delivery Jan. 1st, 1917.

No. HZ-1488 "Professional" Wave Meter **$8.00**



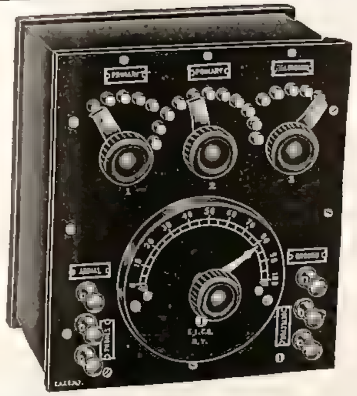
Professional Loose Coupler. The 1917 model of the best coupler on the market at its price. Note the size, $15\frac{1}{2}$x$7\frac{1}{2}$x$7\frac{1}{4}$. Tunes up to 3000 meters easily. Navy type switch on secondary with 10 points. Shipping weight, 10 lbs.

No. HX-14000 Professional Loose Coupler.... ... ... **$8.00**



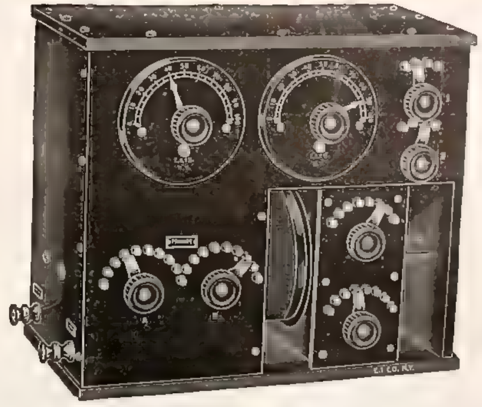
Sayville (WSL) Radio Outfit. 2500 meters wavelength. A de luxe cabinet that is compact, efficient, good looking and yet is not expensive. All tuning is by switches, and the front is of Bakelite, the metal highly nickeled and the case is of hand-rubbed **mahogany**. Size, 12x10x$5\frac{1}{2}$. Shipping weight, 9 lbs.

No. AHX-4455 Sayville (WSL) Radio Outfit (no phones) **$18.00**



Key West (NAR) Radio Outfit. 2000 meters wavelength. Combines more value in a small outfit than any outfit we make. Has made some wonderful long records in tests. **Bakelite** front, nickeled metal, and hand-rubbed **mahogany** case. Size, 8x8x$4\frac{1}{2}$. Shipping weight, 6 lbs.

No. ADX-4444 Key West (NAR) Radio Outfit (no phones) **$14.00**



Nauen (POZ) Radio Outfit. 3500 meters wavelength. Made to do just what its name implies, to receive European messages, **and does it.** Has a remarkable Navy type receiving transformer and condensers. Entire front of **Bakelite**, metal highly nickeled and case, size $17\frac{1}{2}$x$11\frac{1}{2}$x7, is of hand-rubbed **mahogany**. A perfect instrument at a very reasonable price. Receives up to 3500 meters without extra coils. A real bargain.

No. CLX-04477 Nauen (POZ) Radio Outfit (no phones)........ .... **$39.00**

Tuckerton (WGG) Radio Outfit. Receives long and short waves in great style. Has the most wonderful Navy type loose coupler you have ever seen. All fronts of **Bakelite**, metal nickeled and case of hand-rubbed **mahogany**. Size, $21\frac{1}{2}$x7x$6\frac{3}{4}$ in. Shipping wt., 15 lbs.

No. BVX-4406 Tuckerton (WGG) Radio Outfit (no phones). **$26.00**

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Yes, entirely free. Our big, new electrical cyclopedia No. 18 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 200 Big Pages, 600 illustrations, 500 instruments and apparatus, etc. **New Art Section** contains finest Radio Outfits made. Big **"Treatise on Wireless Telegraphy."** 20 FREE coupons for your 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 18 measures 7x$5\frac{1}{4}$". Weight $\frac{1}{2}$ lb. Beautiful stiff covers.

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Now before you turn this page write your name and address on margin below, cut or tear out, paste on postal card and the Cyclopedia is yours by return mail.

THE ELECTRO IMPORTING CO., 236 Fulton St., N. Y. C

THE ELECTRO IMPORTING CO. FULTON ST., NEW YORK, N. Y.

Experimental Chemistry

By Albert W. Wilsdon

Eighth Lesson

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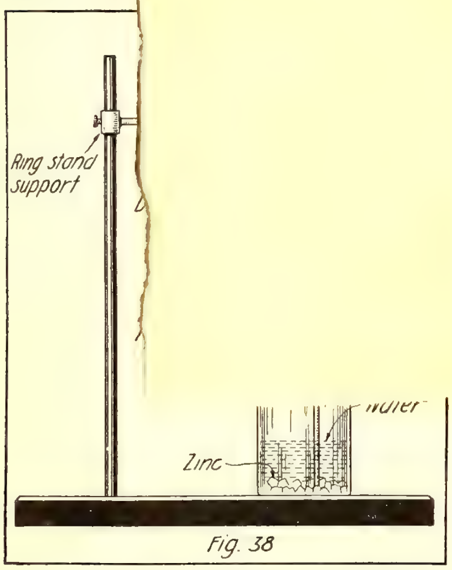
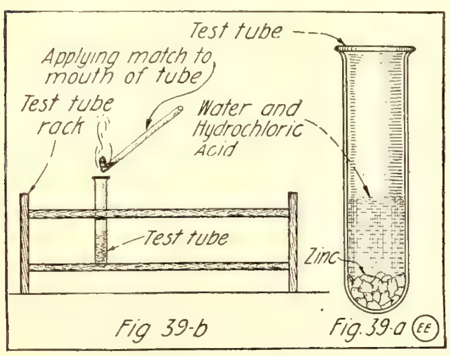


The Preparation of Hydrogen by Upward Displacement. Reaction of Zinc and HCl.

10 cc. should be sufficient. Watch the action and make notes of what happens in the water and to the Zinc.

[It may be found that the above quantity of acid will not produce any visible action on the Zinc, if such be the case add a few cc. more. If upon the addition of more acid, the reaction does not take place with fairly rapid evolution of gas, you may gently heat the solution over a Bunsen burner, holding the tube by means of a test tube holder, for a few minutes, or in other words till gas is generated, evidenced by the rapid flow of bubbles thru the tube. Be careful not to let the solution boil, and if it has a tendency to do so remove the tube from the flame.]

After generating a few minutes [which is made apparent by the evolution of small gas bubbles] apply a lighted splint to the mouth of the tube, and record the results.



(At Left)—Evolution of Hydrogen by Reaction of Zinc and Dilute Hydrochloric Acid. (At Right)—Showing Water and Acid Solution and Zinc.

Compare these results with those obtained by Experiment No. 23.

The reaction which is taking place in the tube is as follows:

$$Zn + 2HCl = ZnCl_2 + H_2$$

Hydrogen

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$_4$ + H_2

Hydrogen

place of the Zinc, after thoroly washing the test tube, if separate tubes are not used, try the reaction of Hydrochloric acid and Iron [Fe], using the same apparatus and procedure as in the preceding experiments. Record your results as before.

The reaction which should take place is as follows:—

Fe	+	2HCl	=	$FeCl_2$	+	H_2
Iron		Hydrochloric acid		Ferrous Chlorid		Hydrogen

After again thoroly washing the tube, try the reaction of Sulfuric acid [H_2SO_4] and Iron [Fe]. The reaction should be:—

Fe	+	H_2SO_4	=	$FeSO_4$	+	H_2
Iron		Sulfuric Acid		Ferrous Sulfate		Hydrogen

EXPERIMENT NO. 28—

In place of the Zinc or Iron, put a piece of Copper [Cu] in a test tube and partially fill with water as in Experiment No. 25. Set the tube in the rack next to either of tubes as used in any of the foregoing Experiments. Add about 5 or 10 cc. of Nitric acid [HNO_3] to the tube containing the copper and water.

Notice the color of the solution, the color of the fumes, etc. Make notes.

After the action has begun with fair rapidity, apply a lighted splint to the mouth of the tube. Compare the results with any of the foregoing experiments. See if you can explain the difference.

Caution:—When carrying out experiments in which Nitric acid is one of the reagents, carefully avoid inhaling any fumes which may arise in the vessels or retorts, as a poisonous gas, Nitrogen Monoxid [NO] is sometimes liberated. It is advisable to work all experiments near a window or where a draft can be created.

The reaction which took place in this Experiment is:—

$3\,Cu$	$+8HNO_3=$	$3Cu(NO_3)_2+$	$4H_2O+$	$2NO.$
Copper	Nitric Acid	Copper Nitrat	Water	Nitrogen Monoxid

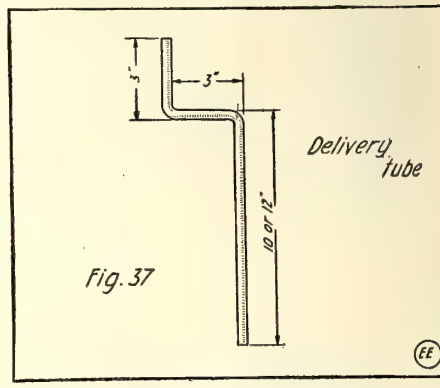
It will be seen from this reaction that no hydrogen is liberated, but the products obtained are Copper Nitrat [$Cu(NO_3)_2$], Water [H_2O] and Nitrogen Monoxid [NO].

EXPERIMENT NO. 29—

Partially fill an 8 ounce bottle with water as shown by Fig. 40. Take a piece of metallic Sodium [see NOTE] about the size of a pea and drop into the water, covering the vessel with a piece of *paper* or *cardboard*. Never use a *glass* plate, as a slight explosion may occur upon the disappearance of the Sodium, and if a glass plate were used to cover the vessel it might result in injury, if the glass should break. Therefore never use glass.

Metallic Potassium [K] may be used in place of the Sodium [Na], in the same manner as above, observing the same precautions.

[*NOTE:—The metallic Sodium [Na] and Potassium [K] are kept under kerosene oil. When a small piece is wanted, take out a large piece from the bottle and roughly wipe off the oil with filter paper, rolling the same on the work-table. Cut off a piece the size needed. It is not advisable to use a piece larger than a pea.*]

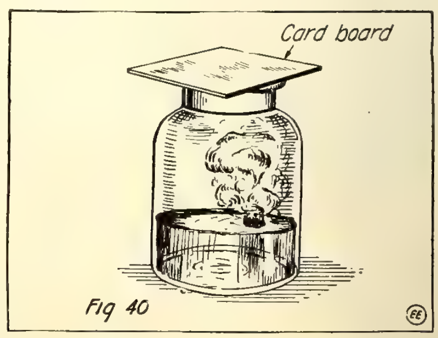


Detail of Glass Delivery Tube Used in Collecting Upwardly Displaced Hydrogen.

Be cautious not to allow any of the Sodium or Potassium to come in contact with the skin, but when handling it, do so by means of a pair of forceps. After you have performed the experiment, it is advisable to hold the forceps with which the Sodium or Potassium was held in the flame of a Bunsen burner and burn off any of the metal which may have adhered to them.

Also be careful not to allow the Sodium or Potassium to come in contact with water, as it readily absorbs the same and may become inflammable. It should be placed in the vessel where it is to be used as soon as possible, and the remaining portion replaced in the bottle containing the kerosene oil, as there is always a percentage of moisture in the atmosphere, which would be readily absorbed by the Sodium.

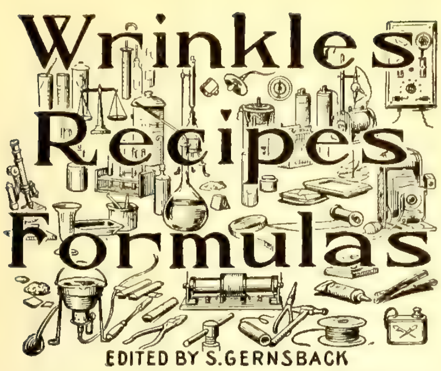
If any of the metal should flame up *never pour water on it to extinguish it*, but have handy a box of sand or loam, and blanket the flame with either of these. To pour water on the flames would cause it to burn with more intensity.



Showing Liberation of Hydrogen by Action of Metallic Sodium or Potassium on Water.

The reactions which accompany the de-

(*Continued on page 692*)



EDITED BY S. GERNSBACK

Under this heading we publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

EXPERIMENTER'S APHORISMS

In the following, we wish to give to the Experimenter some hints as to the use of the different ingredients and how to work them:

(1) Always bear in mind that exact working of a formula requires ACCURACY, CLEANLINESS, PATIENCE, and SKILL.

(2) Know what you are about, before you start to experiment.

(3) "THE HISTORY OF FAILURES IS THE HISTORY OF SUCCESS" goes an old adage, and it applies well to the experimenter.

(4) Many times impure, wrong or deteriorated raw materials, spell FAILURE instead of SUCCESS.

(5) A great many of the chemicals and ingredients required, cannot be obtained from drug stores; buy them at a reputable supply house.

(6) BEFORE CONDEMNING A FORMULA, be sure the fault does not lie with the manner of handling it, or the purity of the ingredients.

(7) Be sure to mix the materials comprising a certain formula in the proper sequence.

(8) When starting to prepare a mixture, especially one containing liquids, ask yourself: "IS THE SPECIFIC GRAVITY CORRECT, AS INDICATED BY A HYDROMETER? IS THE TEMPERATURE RIGHT? IS THE QUANTITY OR WEIGHT RIGHT?

(9) Acids and water, when mixed, should be manipulated in the proper manner, i. e., THE ACID SHOULD BE POURED INTO THE WATER, and not vice versa, as the solution is liable to be forcibly ejected from the containing vessel and into the mixer's face.

(10) For any kind of SYSTEMATIC WORK, a floating THERMOMETER and HYDROMETER, as well as measuring glasses and scales, should always be provided, as GUESSWORK is EXPENSIVE, and SOMETIMES FATAL.

(11) Put labels on ALL bottles, boxes and packages with FULL INSCRIPTION as to their contents, it will avoid troubles and mistakes.

(12) Remember that a beginner cannot expect to make articles AT FIRST, which will compare with regular manufactured products. S.G

MAKING MIRRORS BY ELECTRICITY.

A rapid and admirable method for depositing suitable metals on the surface of glass so as to produce mirrors consists of decomposing the metal by means of a high potential electric current. It is thus described in the *Physikalische Zeitschrift* by G. Rumelin.

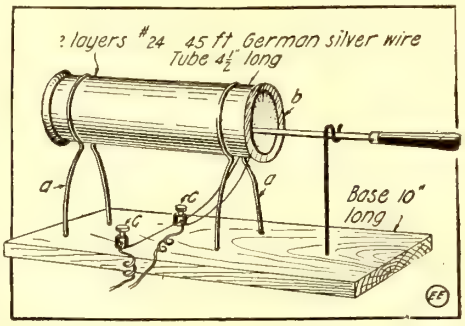
A metal plate is placed in juxtaposition with the glass plate which is to receive the coating. The two plates are then placed flat on a table beneath the receiver of an air-pump suitable for producing a high degree of vacuum, such, for example, as the rotary molecular pump of Gaede.

A small quantity of an inert gas, such as hydrogen, is introduced into the vacuum and a high potential current is then turned on by means of the negative pole of a suitable source of electricity, this pole being attached to the metal plate. Thirty seconds duration of this cathodic flow is sufficient to obtain a properly silvered mirror.

Besides silver such metals as gold, copper, platinum, nickel, iron, palladium and iridium may be employed.

ELECTRIC SOLDERING IRON HEATER.

The tube here shown is made of sheet iron or steel bent around a 1¼-inch pipe. Remove it and bend up the edges about ¼ inch to hold on the winding and insulation. First wind two layers of mica around the tube, then one layer of No. 24 German Silver resistance wire, then two more layers of mica and another layer of wire. The total length of wire is 45 feet or so, as found by experiment. These are brought



Electric Heater for the Soldering Iron, Comprising a Metal Tube Wound with Several Yards of Resistance Wire.

out to the binding posts and connected to the 110 mains. This is a fine heater, heating the iron in 1½ to 2 minutes and will last a long time if properly handled.

Contributed by OSCAR RUZEK.

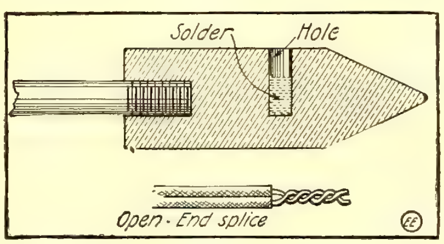
EXPLOSIVE PAPER.

Dissolve some Iodine crystals in aqua-ammonia; the amount makes no difference and the crystals should not be entirely dissolved for best results. Then pour the solution in a filter paper to filter. The precipitate should then be put on different pieces of paper and left to dry. When dry the paper will explode if touched; the thicker the precipitate has been put on the paper the louder the report. A joke can be played on anyone by placing it, when almost dry, where they will touch it when it is dry. Don't handle when dry because it will explode very easily. The explosions are harmless to anyone but they cause heat and for this reason care should be taken where they ignite. The correct proportion can best be found by experiment, since it differs with the material. I found 1 part of Iodine to 5 parts of ammonia to give good results.

Contributed by RUSSEL O. SHADEL.

RELATING TO THE SOLDERING IRON.

I have found that by drilling a hole in the side of a soldering iron and filling it with solder, that splices of the open-end



A Time-Saving Kink for Rapidly Soldering Twisted Wire Joints. A Solder Well Is Formed by Drilling a Hole in the Copper.

style may be soldered with much better results than by using the tip of the iron. The iron is heated until the solder in the hole melts, then the splice, already covered with paste, is pushed into it. This makes a very well soldered joint. The hole should be about ¼" x ⅝".

Contributed by HENRY ABRAHAM.

INK FORMULAS.

1. Ink for Porcelain:—Colophony resin, 20 parts; Borax, 35 parts; Alcohol, 150 parts; Water, 250 parts. Nigrosine in sufficient quantity. Dissolve the resin and nigrosine in the alcohol and the borax in the water and mix both solutions.

2. Stamping Ink:—Manganese phosphate, 30 parts; Hydrochloric acid, 60 parts; Anthracence, 15 parts; Potassium chromate, 7.5 parts; Gum acaia in sufficient quantity; Water, 7.5 parts. Dissolve the manganese phosphate in the hydrochloric acid, make a mixture of the anthracence, potassium chromate and water, and shake. Mix the whole vigorously, adding sufficient gum acaia to maintain suspension.

3. Typewriting Ink:—Transparent soap, 1 part; Glycerine, 4 parts; Water, 12 parts; Alcohol, 25 parts; Aniline dye, sufficient quantity. Dissolve the soap in a mixture of the glycerine and water by aid of heat, and finally the aniline dye dissolved in the alcohol.

4. Red Typewriting Ink:—Bordeaux red, 1 part; Aniline red, 15 parts; Oelic acid, 45 parts; Castor oil, sufficient quantity, approximately 1,000 parts. The coloring matters are triturated with the oelic acid. The castor oil is then added and the whole heated at 100 to 110 degrees, under constant agitation.

5. Red Copying Ink:—Extract of logwood, 80 parts; Water, 1,000 parts. Dissolve with the aid of heat under constant stirring and add Potassium bichromate, 10 parts. After solution is effected add nitric acid, 30 parts. After shaking thoroughly add to thicken dextrin, 60 parts; water, 60 parts; salicylic acid, 1.5 part.

6. Universal Ink:—Extract of logwood, 16 parts; Hot Water, 200 parts. To the solution add Chrome alum, 16 parts; Potassium chromate, 660 parts.

7. Black School Ink:—Extract of logwood, 8 parts; hot water, 180 parts. To the solution add Potassium bichromate, 1.3 parts; hot water, 20 parts; Hydrochloric acid, 3.5 parts.

8. Indelible Ink:—Extract of logwood, 20 parts; boiling water, 280 parts. After solution has been effected, mix it with a liquid composed of solution of Potassium bichromate, 3.5 parts; hot water, 20 parts; Hydrochloric acid, 8 parts.

Contributed by FRED BABBITT.

TO SILVER BRASS OBJECTS.

Mix 3 parts chloride of silver, 20 parts powdered cream of tartar, 15 parts powdered common salt. Moisten a suitable quantity of the mixture with water, rubbed in with a piece of blotting paper. Take the blotter, which should be moist, and rub the article (brass) to be silvered. Wipe off any dust on the article and rub with a piece of cotton which has been dusted with precipitated chalk. Then wash in water and polish with a cloth.

INK FOR WRITING ON METALS.

Formula:
Muriatic Acid ....1 oz.
Nitric Acid ....½ oz.

Cover the portion of the metal you wish to write upon with melted wax and allow to cool. Write the inscription plainly with any sharp instrument through the wax to the metal.

Apply the mixture with a feather or rag, carefully filling each letter, and let it remain from 1 to 30 minutes, according to the depth desired; after which wash off the wax and mixture, and rub over with a little sweet oil to prevent further tarnish or rust.

Contributed by W. P. MENGEL.

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month **$3.00** prize for the best photo. Make your description brief and use only one side of the sheet. Address the Editor, "With the Amateurs" Dept.

AMATEUR RADIO STATION CONTEST.

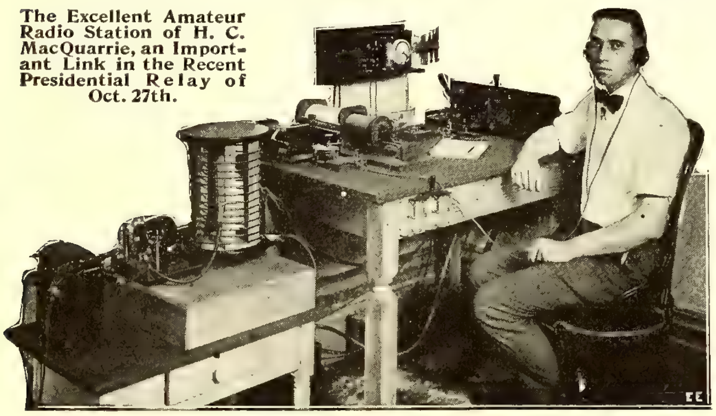
Monthly Prize, $3.00.

This month's prize-winner.

RADIO STATION OF H. C. MACQUARRIE.

The accompanying is a photograph of my station, 6SH. It uses a rotary spark gap and a 1 K.W. Thordarson flexible type transformer on 110 A.C.

The receiving side consists of a loose coupler designed to receive up to 2,500 meters and a loading coil for 2,000 meters more, thus giving a long range in wave lengths; also a variable for use of short waves. I have an Audiotron panel and an interchangeable switch to change to a compound galena detector.



The Excellent Amateur Radio Station of H. C. MacQuarrie, an Important Link in the Recent Presidential Relay of Oct. 27th.

It will be noticed that on the right of the photograph there is a switchboard for all the various controls desirable as in using a double antenna. The tuning is done on the left, leaving the right hand free to write when once the change-over is made.

H. C. MACQUARRIE.

Stockton, Cal.

OCTOBER MEETING OF THE INSTITUTE OF RADIO ENGINEERS.

A very interesting paper was delivered by Edwin H. Armstrong at the meeting of the Institute of Radio Engineers held at the Engineering Societies Building, New York City, on October fourth.

The paper was entitled "A Study of Heterodyne Amplification by the Electron Relay."

Mr. Armstrong's paper dealt entirely with the experimental data obtained. Both the regenerating Audion and the crystal rectifying detectors were employed as receivers for the continuous waves emitted by the regenerative Audion, and which were inductively coupled with the crystal rectifier circuits. Measurements on the amplification values were obtained by means of high resistance coils shunted across a sensitive galvanometer which was used instead of the receiver so that quantitative constants could be determined.

Various curves were shown, indicating the effectiveness of the self-regenerative Audion in its amplification of the received currents as noted by the deflection of the sensitive galvanometer. During the tests a series of measurements were made for the purpose of determining the relation between the maximum signal strength obtainable with a simple electron relay, with separate heterodyne, and again, the signal obtainable when the same relay is supplied with a regenerative circuit and operated as a self-heterodyne. A large number of comparisons were made at a frequency of about 40,000 cycles. The results were extremely irregular due to the very critical nature of the adjustment of the self-heterodyne circuit, but there was found to be an average amplification of about *fifty times* with respect to the signals produced by the externally excited heterodyne.

DARLEY THURNES' RADIO LABORATORY.

In sending radio messages I use a one-inch spark coil, key, gap and helix of my own make; also a glass plate condenser and the necessary batteries and switches.

Mr. Darley Thurnes at His Wireless Receiving Instruments. His Call Is 8 AND.

My receiving is accomplisht with a pair of Brandes' 2,000 ohm 'phones and an 18-inch tuning coil (single slide), fixt condenser, loading coil and four detectors.

With this simple set I am able to hear NAA, NAR, WCX and many of the coast stations. I can also hear all the Amateurs in town. I have a license, my call being 8 AND. I would be glad to exchange photo of my set with other Amateurs.

DARLEY THURNES.

Akron, Ohio.

The entire equipment of a wireless station in Italy which has worked successfully for long distances, including the antennae, is enclosed within a cathedral.

ARLINGTON.

Vesta of younger nations,
Whose flame the old worlds mark,
Mistress of many stations,
That guard the sacred spark—

Tall, from your towered altar,
In speech that links the miles,
You parley grim Gibraltar
Or far Pacific isles!

Carnarvon spoke your minions
E'er had she donned her mail;
The Eiffel's unseen pinions
Pass yours above the gale.

They know your sister greeting
From Charleston, round the Keys,
To Ketchikan, completing
Your circuit of the seas.

Where alien dusks are falling
On beach, or plain, or pine,
They bless your far key calling
In high, staccato whine!

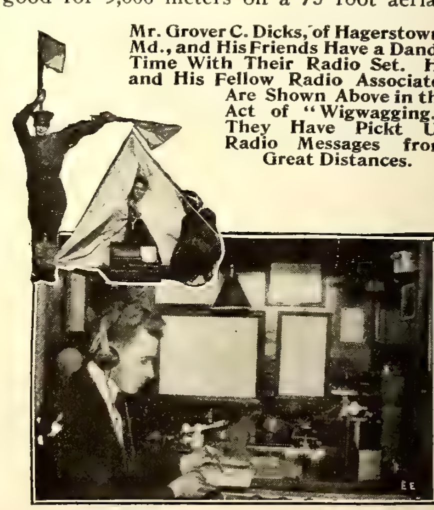
Vesta of younger nations,
From coral-crusted bars,
Or peaks, or bays, your stations
Call back beneath the stars!

KADRA MAYSI.
(New York Times.)

GROVER C. DICKS A RADIO ENTHUSIAST.

The sending set comprises a Gernsback electrolytic interrupter, 1 inch Electro Bull-Dog spark coil, Electro adjustable high tension condenser, commercial spark gap, Murdock wireless key and oscillation transformer.

My receiving set is enclosed in a finely finished cabinet The receiving set consists of E. I. Co., loading coil, Chambers loose coupler, fixt condenser, Crystaloi detector (type A), and Radiograph detector, home-made tuning coil, 28 inches long and good for 9,000 meters on a 75 foot aerial, 150 feet high and Brandes' 3,000 ohm receivers.



Mr. Grover C. Dicks, of Hagerstown, Md., and His Friends Have a Dandy Time With Their Radio Set. He and His Fellow Radio Associates Are Shown Above in the Act of "Wigwagging." They Have Pickt Up Radio Messages from Great Distances.

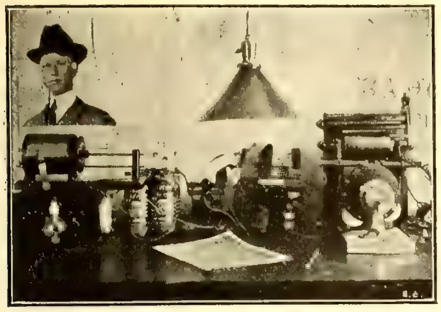
GROVER C. DICKS.

Hagerstown, Md.

RADIO SET OF K. T. REDICK.

I submit photo of my radio station which I trust will find its way into your *Radio Station* contest columns.

A 1 K.W. Thordarson transformer, five sections of Murdock moulded condenser, a



K. T. Redick Enjoys His Nifty Wireless Set Immensely. Get Him on the Ether, "Bugs"—Call 1 DY.

Murdock oscillation transformer and a Blitzen rotary gap constitute the transmitting set. I have changed the gap so that it will carry the heavy spark of the 1 K.W. transformer.

My receiving set is composed of an Audion, a Murdock loose coupler and a pair of Brandes' receivers.

The high frequency connections in the sending set are kept down to about the minimum of length. Consequently, I have a short, sharply defined wave length even though I have a large aerial. The set is thoroughly up-to-date and does excellent work. My call is 1 DY.

K. T. REDICK.

Newington, Conn.

RADIO STATION AT NAVASSA ISLAND.

A radio station has been installed and is now in operation at Navassa Island light station, West Indies. This station is operated at present by the contractors for the erection of the light station, and it will be operated by the United States lighthouse service when the light station is completed.

U. S. WIRELESS MOTORCYCLE SET SUCCESSFUL.

There is something new under the sun. The army has it.

Out at Fort Sam Houston recently General Funston inspected the brand-new and only military motorcycle wireless outfit.

This latest comer consists of sending and receiving apparatus carried in the side cars of three motorcycles. A dynamo attachment is provided to be run by the engines of the motorcycles. The dynamo furnishes the power for sending messages, and is said to be far superior to the hand-power system that has been in use. Seven enlisted men are required to the outfit.

One of the features is an aerial or tower of hinged steel capable of being raised to a height of forty feet.

Major Walter J. Clarke and First Lieutenant Howard C. Tatum of the Signal Corps are responsible for the motor attachment, they having made extensive experiments.

A tryout was given the motorcycle set by taking it to Boerne and communicating, within just one hour and thirty-three minutes after leaving San Antonio, with the big plant at the Post. The messages sent and received were highly satisfactory. The distance was thirty-three miles and conditions were favorable. It was said that the outfit can be depended on for thirty miles where static conditions are good.

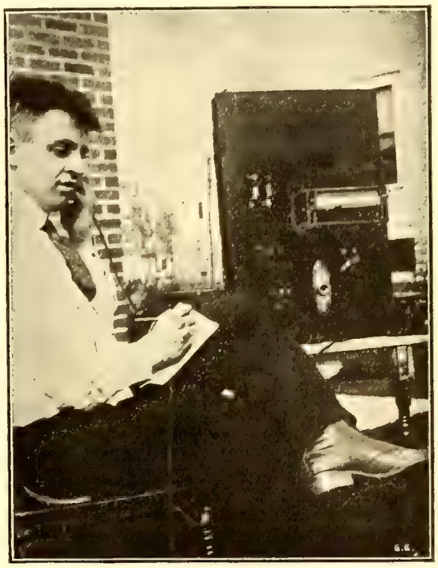
RADIO STATION OF MAYNARD BODLEY.

The accompanying picture shows my wireless station.

The aerial is 74 feet high and 67 feet long and is composed of four strands of copper wire. The receiving set contains a galena detector, a home-made fixed condenser, one loading coil and one 85 ohm 'phone, also a home-made loose coupler.

The sending set consists of a 1-inch coil, E. I. Co. spark gap, mounted inside of the cabinet, aerial switch, key, helix and high-tension condenser.

I obtain very good results with this set and am a steady reader of THE ELECTRICAL



Mr. Bodley Is a Radio Enthusiast and Spends Many Pleasant Hours "Listening In" to the Amateurs and the Big Fellows as Well.

EXPERIMENTER. I think it the best magazine ever put out.

MAYNARD BODLEY.

St. Paul, Minn.

Amateur News

High School Radio Club of Monroe City, Mo.

This club was organized at the beginning of school session, 1915-1916, at Monroe City High School. The club has eight members and the station is located within the school building. The antenna consists of four-strand copper wires, 85 feet long, being 85 feet in height at one end, and 75 at the other.

The sending set comprises a ½-kw. Packard 13,200 volt transformer, oscillation transformer, rotary and fixed spark gaps, condenser and protective device. The receiving set consists of a Navy type loose-coupler, silicon and Galena detectors, loading coil, variable and fixed condensers, and 2,000 ohm phones.

The officers of the radio club are Russell Longmire, president; Harry Longmire, secretary-treasurer; Bert Emerson, chief operator and engineer. All communications should be addressed to the secretary at Monroe City, Mo. The club would like to hear from all nearby amateurs.

Rockaway Radio Club of Rockaway Beach, L. I.

Amateur radio telegraphers in the vicinity of Rockaway, L. I., have succeeded in organizing the Rockaway Radio Club. The following officers have been elected: President, H. Conway; Vice-President, R. Richter; Recording Secretary, L. Wagerer; Financial Secretary, H. Fingerlin; Treasurer, J. V. Byrne; Sergeant-at-Arms, L. Anderson.

For the convenience of the members, a library has been established. E. Richter and W. Byrne were appointed librarians, to take charge of it.

This club, because of its ideal location, has on its roster some of the most prominent in the scientific world. It has for its honorary members such men as Dr. Lee de Forest, L. R. Krumm, chief radio inspector; ex-Police Commissioner J. Hussey; Lawyer F. Davies, and J. V. Byrne and J. Madden, two noted Rockawayites.

Over one-third of the club's members have received first-grade Government licenses. Very interesting lectures are given each week by various members. By the consistent efforts of the instructors, H. A. Conway and R. Richter, new members are taught the code and assisted to obtain operators' licenses.

Some long-distance receiving is also being regularly accomplished. Operator R. Richter has done some excellent work with his oscillating audion set, having succeeded in clearly reading the arc set at Darien, Isthmus of Panama, also the stations at Charleston, S. C., Arlington, Va., and numerous other stations using the arc transmitter. Address all communications to L. Wagerer, 122 Boulevard, Rockaway Beach, L. I.

Roxborough Wireless Association of Philadelphia, Pa.

The members of the Roxborough Wireless Association, which has been but recently organized, are very enthusiastic and the outlook for the club in the future is very bright indeed. The officers elected for the coming year are: President and treasurer, Ernest McGee; vice-president and secretary, Earl Henson.

All communications are to be addressed to the secretary, Mr. Earl Henson, 6200 Ridge Avenue, Philadelphia, Pa.

East Liberty (Pa.) Y.M.C.A. Wireless Club.

Besides the regular wireless club's meeting of the East Liberty Young Men's Christian Association, held at 8 p.m. every Monday night, the club is offering a course in commercial operation and care of a radio station at its headquarters, third floor of the Y.M.C.A., Room "F." This course will be given by a widely known teacher on the subject.

For further information communicate with the club's secretary, Earl W. Hepner, 450 Morgan Street, Pittsburgh, Pa., or call Bell 'phone "Schenly 1325-W."

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur News" Section, The Electrical Experimenter, 233 Fulton St., New York City.

Radio Club of Westchester, N.Y.

The Radio Club of Westchester, New York City, was organized recently and holds its meetings at its headquarters, 2320 Newbold Avenue, Bronx, New York City, every Tuesday evening.

The club has installed a ½ K.W. transmitter and a receptor of the loose-coupled type. The call letters are 2 EW. Besides the usual lectures delivered at each meeting, code practice is held thereafter and a most interesting series of lectures is being prepared for the near future. The officers are: President, Herman Buschow; vice-president, Werner Hauptli; secretary and treasurer, Alfred H. Hausrath, Jr.

If interested, write for further information to Mr. Alfred H. Hausrath, Jr., 1866 Cedar Avenue, Bronx, New York City.

Benjamin Franklin Science Class.

On November 11, 1915, a number of "live wire" boys organized the Benjamin Franklin Science Class. The club has established a well-equipped scientific laboratory. At the graduation exercises of the High School the club gave an exhibition on Wireless Telegraphy and Mineralogy. The club anticipates sending in a photograph of its members and laboratory shortly. It is active in the fields mentioned above. Address all communications to Anthony Marino, 511 Traphagen Street, West Hoboken, N.J.

Allentown, Pa., Operators Organize.

At the home of John R. Scholl, 1318 Turner street, a number of amateur wireless operators recently formed a society to be known as the Inter-City Radio Association of Allentown. The organization will be for the benefit of amateur radio operators in this city.

The following officers were elected: John S. Bernhard, president; William J. Kreis, secretary; John R. Scholl, solicitor; David A. Goodling, association inspector. Operators wishing to join the club can get the desired information by communicating with the above.

New Audion Apparatus for Radiophony and Amplifying

A LOW power radio telephone transmitting set for amateur and private installations has just been brought out by Dr. de Forest and is shown in the accompanying illustration. This compact set comprises an oscillation or large Audion tube used as a generator for high frequency currents and may be seen on the front of the panel. It is capable of delivering a sustained wave current of .5 ampere. It is supported on the panel by means of two soft, rubber-covered spring rings. The filament current is obtained from a 12-volt storage battery and is directly controlled from the panel by means of a rheostat stationed at the lower right-hand corner.

The oscillatory circuit consists of a fixed capacity and variable inductance. The two are indicated in the back while the inductance is controlled by means of a multiple switch, shown at the upper left-hand corner. The current passing into the aerial is observed on the hot wire ammeter and the microphone transmitter, which is of unique design, is supported on a movable bracket and is connected in the grid and wing circuit. The exact connections are not at present available owing to patent reasons.

The high voltage current supplied to the wing electrode is obtained from a 500-volt, direct current generator, driven by a motor. This is seen at the left of the switchboard. The dynamo is of special design in order to give an absolutely constant potential of 500 volts.

The complete outfit is extremely compact and light in weight, excluding the motor generator, and is capable of transmitting speech up to twenty miles and more with a suitable antenna.

One of the latest products of Dr. de Forest's laboratory is a unique type of single bulb Audion receiver which performs three distinct functions, viz., it may be used for receiving spark signals, or as a receiver for sustained (undamped) waves, and last, for amplifying the incoming signals. All these functions are performed by this single bulb instrument illustrated herewith.

The Audion is specially built for this kind of work, and is shown at the left of the panel. The filament current is controlled by a rheostat, enclosed in the bottom of the case. The amount of current consumed by the filament is indicated by the ammeter to the right of the Audion.

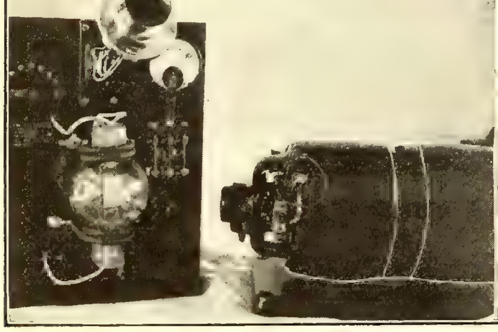
The wing current is regulated by means of a carbon plate potentiometer, which is plainly shown at the upper right-hand corner of the cabinet. The multiple point switch next to the ammeter regulates the capacity of the grid condenser or so-called *stopping* condenser. The lower or bridge condenser switch is connected with a fixt condenser, composed of several sections, which is shunted across the wing and grid electrodes.

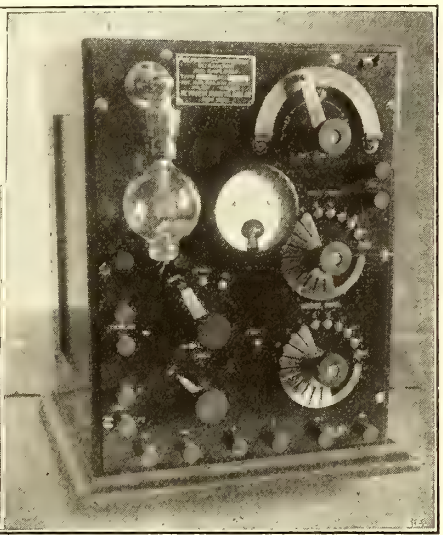
The three-point switch beneath the Audion is used for connecting it in the circuit in such a manner as to render it possible to be used as an amplifying receiver for spark and arc stations. This is done by merely placing the switch lever over the proper contact.

The complete unit is of course connected with the regular tuning instruments. This outfit is highly desirable for locations where space is at a premium and also when it is desired at the same time to have available three different functions in the receiving apparatus. The United States Navy has adopted it as the standard.

At Right—De Forest Amplifier, Detector and Beat Type Standard U. S. Navy Receiving Cabinet Enables the Circuits to be Changed for Arc or Spark Signals.

Below—Oscillion Type of De Forest Wireless Telephone Suitable for Amateur and Private Use.





GERMANS "JAM" ALLIES' RADIO.

The Germans have scored a victory in the ether. The *Giornale d'Italia* announces that the powerful sending station in Berlin has been "jamming' the announcements of the Allies and preventing their being received by vessels on the high seas. While unable to jam the powerful Eiffel tower station in Paris, the Germans are successfully jamming the little stations. This is the natural conclusion of the refusal of the Allies to jam the German wireless it is said. This is one branch of the fighting in which the Allies are still content to leave the initiative to their enemies.

NEW WIRELESS STATIONS FOR MONTANA POWER CO.

The wireless station installed by the Montana Power Company near the Rainbow Hotel at Great Falls, Mont., is in daily communication with the station of the company on Spring Creek. Engineer Campbell of the Spring Creek plant has installed the stations after detailed experiments, some of which have produced remarkable results.

The ability to communicate by wireless will prove of great advantage to the company, especially in case of storm, or at any other times when its private lines are out of commission. A saving of considerable money spent for long distance telephone service when its own wires are down, will be effected, it is said, by the wireless.

In Central America there is a large radio antenna supported from a lofty tree.

The Ham What Am

(With all due apologies to a well-known brand)

By Paul Oard.

In the static room on the hurricane deck,
The work for the day was done;
And the operator yawned contentedly,
And thought of a snooze well won.
In the sea to the West the sun had sunk down,
Marking the close of the day;
So he set his call for the second man
And made ready to hit the hay.

But when he had laid his 'phones on the desk,
Thru the whistling sparks 'long the shore,
There came a call thru the tangled mess,
With a tone twixt a grunt and a snore.
And the call was for him, to his disgust;
The sending switch closed with a snap,
While an angry reply barked from his key
And spread itself over the map.

To his QRA came back the spark
Like shot when it falls in a lake,
And his turbulent thoughts were of that place
Where all good books say we'll bake;
To his startled ear came the answer clear,
In accents of a lamb:
"G E, old man, do you get my spark?
This Am the Ham what Am!"

His current climbed to sixty amperes,
And the ether choked with juice,
In stern rebuke his spark shot out,
Tho he knew 'twas of little use;
And down thru the atmosphere,
From the key of the hopeless ham,
Came back the answer,
"G E, old man, this Am the Ham what Am!"

In the hot engine room three decks below,
The Chief in angry surprise,
Watched the juice race over the board,
And the Ammeters jump to the skies.
Something was wrong, that much he well knew,
But he did not know that the Ham
Was patiently peddling his call through the air:
"This Am the Ham what Am!"

The op'rator's hair stood on end in rage,
Lifting his 'phones off his head,
On the desk he laid them peevishly,
As he thought of his waiting bed;
But as he tost in his bunk,
Thru his dreams of the awful ham
Came this reply to his QRA:
"This Am the Ham what Am!"

EIGHTY SHIPS SAVED BY RADIO FOR FISCAL YEAR 1915-16.

The September number of the *Radio Service Bulletin*, issued by the Department of Commerce, contains a very interesting list of marine disasters in which wireless figured for the fiscal year ending June, 1916.

There are eighty cases cited in the list, and the lives of thousands of persons were saved, all due to the S.O.S. call.

It is quite evident, in looking over this large number of cases of marine disasters that in a very large percentage of them there would have been practically, and without doubt, a total loss of life had it not been for the radio telegraph apparatus carried by them.

In some cases the ship in distress was tost about for many hours before assistance arrived, which makes these annals of the sea all the more extraordinary, as it has not been uncommon for the succoring ship to travel 100 miles or more before it arrived in the vinicity of the distrest craft.

NEW WIRELESS LAW PLANNED.

(*Continued from page 649*)

munication; the words "transmitter" and "receiver" to mean the sending and receiving apparatus, respectively, used in radio communication; the word "radiogram" to mean any message, communication, or signal, transmitted or received in radio communication; the term "radio station" to mean a place where apparatus is used for transmitting, or for transmitting and receiving, the signals used in radio communication; the term "Government land station" to mean any radio station on land, or on a permanently moored vessel, controlled and operated by any department of the Government; the term "Government ship station" to mean a radio station on any ship of the Government controlled and operated by any department of the Government and not permanently moored; and the term "Territory of the United States" or the word "Territory" to mean any Territory, District, Zone, insular possession, water, or other place subject to the jurisdiction of the United State, and not within any State.

The word "person" as used in this Act shall be construed to import both the plural and the singular and to include a corporation, co-partnership, company, or association; and when construing and enforcing the provisions of this Act, the act, omission, or failure of any director, officer, agent, or employee of such corporation, co-partnership, company, or association acting within the scope of his employment or office shall in every case be deemed to be the act, omission, or failure of such corporation, co-partnership, company, or association, as well as that of the person acting for or on behalf thereof.

Sec. 2. Radio stations are divided for the purposes of this Act into the following classes:

1—Coastal station, a station on land or on a permanently moored vessel used for the exchange of correspondence with ships at sea. Coastal stations include (a) those open to general public correspondence, and (b) those open to limited public correspondence. Coastal stations of class (b) transmit and receive public messages to and from certain stations only, which are designated in the license.

2—Station on shipboard, a station on board any vessel not permanently moored. Stations on shipboard include (a) those open to general public correspondence, and (b) those open to limited public correspondence. Ship stations of class (b) transmit and receive public messages to and from certain stations only which are designated in the license.

3—Commercial station, a land station used in the transaction of commercial business and not used for the exchange of correspondence with ships at sea. Commercial stations include (a) those open to limited public correspondence, (b) limited commercial stations, (c) special stations for transoceanic or transcontinental communication. Commercial stations of class (a) transmit and receive public messages to and from certain stations only, which are designated in the license. Limited commercial stations (class b) are stations of private interest, and carry on a specific commercial service or services defined in the license; they do not transmit public messages to, or receive them from, other stations. Special stations of class (c) are open to limited public correspondence or not, as stated in the license.

4—Experiment station, a land station of private interest actually engaged in conducting experiments for the development of the science of radio communication or the apparatus pertaining thereto.

5—Technical and training-school station, a land or ship station of private interest used for purposes of instruction in radio communication and training operators.

6—Amateur station, a land station of private interest not covered by (3), (4), or (5) of this Section, and not operated for financial profit. Amateur stations include (a) general amateur stations, (b) restricted amateur stations, which are within five nautical miles of a Government station, (c) special amateur stations, the operation of which seems likely to result in some substantial benefit to radio communication.

7—Government station, a station controlled and operated by any department of the Government.

Sec. 3. Nothing in this Act shall be construed to apply to the transmission or exchange of radiograms or signals between points in the same State, if said transmission or exchange shall not interfere with the reception of radiograms or signals from beyond the jurisdiction of the said State, or the effect thereof shall not extend beyond said jurisdiction.

Sec. 4. No radio station other than those belonging to or operated by the United States shall be used by any person within the jurisdiction of the United States to transmit any radiogram by the apparatus and methods of radio communication, except under and in accordance with a station license issued by the Secretary of Commerce.

Any person who shall operate any radio station in violation of this Section shall be punished by a fine not exceeding five hundred dollars for the first offense, and by a fine not exceeding one thousand dollars, or imprisonment for not more than one year, or both, for each offense thereafter; and any radio apparatus operated in violation of this Section shall be subject to forfeiture.

Sec. 5. The Secretary of Commerce shall fix the rates charged by all licensed stations open to public correspondence.

The heads of Government departments having jurisdiction over Government land stations and Government ship stations shall, in their discretion, so far as it may be consistent with the transaction of Government business, open such to general public business, and shall fix the rates for such service, subject to the control of such rates by Congress. Such executive heads shall arrange, each in his own department, and for stations under his own jurisdiction, for the transmission and receipt of commercial radiograms between land stations and vessels at sea, between land stations and licensed radio stations within the United States or any territory thereof, and between land stations and radio stations under foreign jurisdiction, under the provisions of the London Convention of nineteen hundred and twelve and future international conventions or treaties to which the United States may be a party. The receipts from such radiograms, less an amount not to exceed twenty-five per cent per annum for the necessary expenses of each department for the handling of such commercial business, shall be turned into the Treasury as miscellaneous receipts.

No radio station other than that belonging to or operated by the United States, or by the Government of the Philippine Islands, shall be operated on land or on a permanently moored vessel in the Canal Zone, or in the Philippine Islands, or in any territory of the United States in the West India Islands other than Porto Rico, or in the Pacific Ocean west of the one hundred and sixty-first meridian of longitude west of Greenwich and south of the fortieth parallel of north latitude.

Every Government land station and Government ship station shall have special call letters which shall be designated and publisht by the Department of Commerce in a list of radio stations of the United States.

Sec. 6. After three months from the passage of this Act and at any time within five years after the expiration of said three months, but not longer, the Government through the Navy Department shall have authority to acquire by purchase at a reasonable valuation any coastal radio station now in operation in the United States which the owner "may desire" to sell.

Sec. 7. The station license required by Section 4 hereof shall not be granted to any alien, nor to any company, corporation, or association of which any officer or more than one-third of the directors are aliens or of which more than one-third of the capital stock is owned or controlled by aliens or by a foreign government or representative thereof or by any company, corporation, or association organized under the laws of a foreign country; and a license shall become void if ownership or management of the station or apparatus shall be transferred to any alien, or to any company, corporation, or association of which any officer or more than one-third of the directors are aliens or of which more than one-third of the capital stock is owned or controlled by aliens or by a foreign government or representative thereof or by any company, corporation, or association organized under the laws of a foreign country.

A license shall not be granted if, in the opinion of the Secretary of Commerce, the operation of the proposed station will seriously interfere with the operation of existing Government or licensed stations in the vicinity.

Sec. 8. The station license prescribed by Section 4 hereof shall be issued only in response to a written application therefor, addrest to the Secretary of Commerce, which shall set forth the following facts:

1. The name and address of the applicant, the date and place of birth, and, if naturalized, the date and place of naturalization.
2. If the applicant is a corporation, the date of incorporation and under what laws incorporated, the principal place of business of the corporation, the names and addresses of the officers and directors, a statement as to each officer specifying his place of birth and the country of which he is a citizen, and, if a naturalized citizen of the United States, the date and place of naturalization, and a statement showing what proportion of the capital stock is owned or controlled by aliens, by foreign governments or representatives thereof, and by companies, corporations, or associations organized under the laws of any foreign country.
3. The ownership of the station and apparatus.
4. The exact location of the station.
5. The stations with which it it proposed to communicate.
6. The purpose or purposes for which the station is to be used.
7. The wave-length or wave-lengths which it is proposed to use at the station and the period or periods of the day during which it is proposed to operate the station.
8. The proposed rate to be charged per word.
9. Such further information as the Secretary of Commerce may, by regulation, prescribe.

Every application shall be signed by the applicant upon oath or affirmation. If the applicant is a corporation, the application shall be signed upon oath or affirmation by at least two officers thereof.

(*Continued on page 696*)

THE PLIOTRON OSCILLATOR.

(*Continued from page 651*)

page 250.) For the correct operation of the pliotron as an oscillator it is very important that the potential returned to the grid for excitation has the correct amplitude and phase relation with respect to the plate current. The frequency of the alternating current which a self-exciting system of this type generates will, of course, depend on the electrical constants of the circuits. Various connections have been devised for this purpose. In practice, either one of two general methods is employed, or a combination of the two; that is, sufficient energy is supplied the grid to keep the system oscillating either by electromagnetic or electrostatic coupling. The production of currents of very low frequencies (0.5 cycle per second) as well as those having very high frequencies (50,000,000 cycles per second) are attainable by means of this tube. In this case it is necessary to reduce the inductance and capacity of the circuits to a minimum; in fact, the natural capacity between the elements inside the pliotron bulb is more than sufficient to supply electrostatic coupling between the plate and grid circuits.—*Photo courtesy General Electric Co.*

MOONLIGHT ON TAP.

(*Continued from page 631*)

soft that it lost its shape.

Since moonlight often gives the impression of bright silver, it was decided to try a reflector coated with silver. The result was highly satisfactory and the sought after illusion of a pure white quality of light produced.

All reflectors now in use are made from glass which has been specially treated to resist heat, coated with pure silver. Extremely important is the fact that a constant current of air is forced across them keeping them at a safe temperature; otherwise the heat generated by the bulbs would melt the entire apparatus.

The following principles have clearly been established in producing the illusion of moonlight. White light must be thrown on greens and foliage, otherwise they will appear black; blue light must be cast on white absorbent backgrounds, such as architectural structures, else they will appear flat and lifeless; and iridescent lighting must play on statuary to bring out and accentuate the true beauty of lines and shadow.

The effect produced by the changing, multi-colored lights on the fountain in the inner garden and the urn at the end of the long walk, is something of a mental shock to the beholder; and it was calculated to be just that. It was found that a note of action was needed in the scene to produce a satisfying stimulating effect. The delicate, varying colors with their gradual changes in intensity catch the eye, arrest the attention and thus force the mind to note the unusual loveliness of the entire garden.

CORRECTION NOTICE.

We have to thank Mr. Michael Rozewski, one of our readers, for kindly calling our attention to an error in the article—"Radiation Current in Radio Antennae"—page 495 of the November issue. The logic set forth and the formulae given are correct. However the first example cited for the calculation of the power in watts radiated should read 98.6375 watts instead of 88.6375 watts, and the approximate watts radiated should be 98 watts, not 88 watts. In the last paragraph of the first column—read radiation as 98.6 watts and set 9.8% efficient instead of 8.8 efficient.

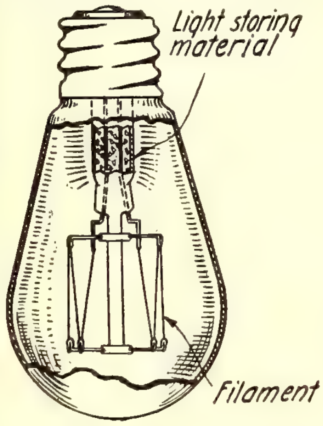
LATEST PATENTS

Luminous Electric Bulb

(No. 1,200,040; issued to James Buckner Speed.)

A very ingenious method of mounting phosphorescent materials within an incandescent electric light bulb. The chemical materials are held in the glass lead-in tube, thru which the filament feed wires pass as indicated. With this arrangement the bulb will give forth a glow for several hours after it has been extinguished, enabling one to readily find it in the dark.

The light storing material may consist of a mixture of powdered glass and some sulfide of calcium or sulfide of zinc. This after-glow illuminating element is therefore



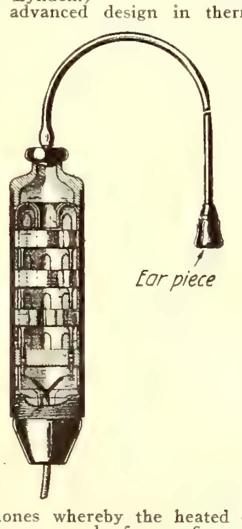
dependent only upon the light given by the filament of the lamp when lighted, and not upon any external source of light.

The function of the glass or quartz granules mixed with the zinc sulfide, is to separate the particles and thus permit the light rays to thoroly permeate the whole mass, thus, of course, raising the effectiveness of the device.

Thermic Telephone

(No. 1,200,470; issued to Piete de Lange and Robert Aernout Baron van Lynden.)

An advanced design in thermic



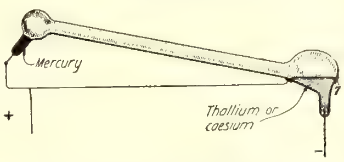
telephones whereby the heated elements, composed of very fine platinum wire, is not placed within the ear; but instead a number of these heating units are contained in a cylindrical chamber, one above the other, as shown.

The composite sound effect, resultant from all of the heated wires co-acting, is carried thru a central orifice and out thru a flexible rubber tube to an earpiece which is placed within the auditory passage of the human ear. The various filaments are mounted on rings as shown, each ring automatically closing its own circuit as it is placed within the container shell by means of two switch plugs and sockets.

Ultra-Violet Ray Generator

(No. 1,197,629; issued to Peter Cooper Hewitt.)

An improved form of ultra-violet



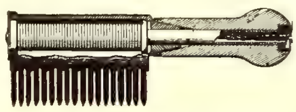
ray generator resembling a mercury vapor lamp. Mercury is used for the positive pole and thallium or cæsium for the negative pole. These are placed in an exhausted chamber and a starting band (7) is provided at the negative electrode cup. As the passage of current thru the devices vaporizes the thallium or cæsium, this material gives off powerful ultra-violet rays under the influence of the current, which rays may be utilized for various purposes.

In starting, the negative electrode metal being solid, it may be subjected to a momentary high potential or to a source of heat to liquefy it. This action will yield a large quantity of such rays, having a wave length of .000002 to .000004 meter.

Electric Hair Drying Comb

(No. 1,197,872; issued to Aiken C. Taylor.)

An electrically heated comb for

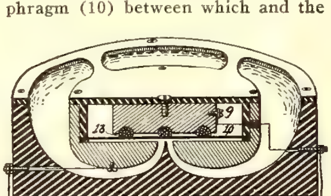


use in ironing and drying a lady's hair which is provided with extended teeth as shown. The chamber of the comb contains an electrical resistance coil supplied with current thru a flexible cable carried thru the hollow handle. It is intended principally to facilitate the ironing and drying of hair. It is especially designed to be readily taken apart, cleaned and reassembled in a substantial manner. The design is very rugged and the comb may be thoroly sterilized in liquid without danger of wetting the heater.

Sensitive Microphone

(No. 1,201,343; issued to Stephen C. Porter.)

In this improved super-sensitive telephone transmitter, particular attention has been given to the design of the acoustic chamber, so that sounds striking the openings in the microphone will be caused to act integratively on the diaphragm (10) between which and the



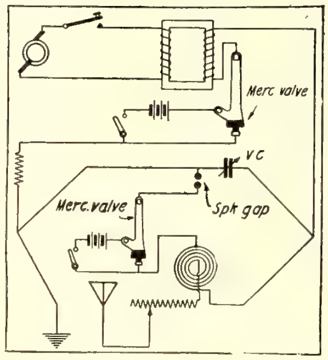
carbon block (9) are placed a quantity of carbon granules, 13.

The sound passage extends all the way around the microphone housing. The instrument is used in connection with an ordinary battery and receiver and is useful in aiding the deaf to hear and for collecting sounds which occur within a reasonable distance off, say, 15 feet away or more. The receiver used with such devices has invariably to be wound to a low resistance—about 6 ohms.

Mercury Valve Radio Transmitter

(No. 1,199,213; issued to Frederick G. Simpson.)

This radio transmitter utilizes a transformer to raise the potential of the primary circuit and the secondary currents are caused to pass in a uni-directional manner thru a mercury valve, as shown. The battery connected to the valve is for the purpose of starting it. The oscillatory circuit discharges from



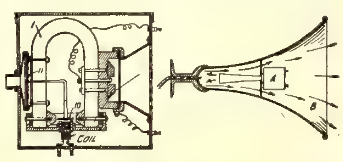
the condenser are also past thru a mercury valve so as to have a uni-directional character.

Thus, electrical impulses of like polarity only can reach the condenser. When the condenser has reached a sufficient potential it will discharge thru the spark gap and second mercury valve to the aerial circuit. By this means a special adjustment of the distance between the spark gap electrodes becomes unnecessary and oscillations in the trigger circuit cannot take place, irrespective of the adjustment or non-adjustment of the spark gap.

Sound Transmitter and Reproducer

(1,201,060; issued to Nathan A. Kurman.)

This invention concerns loud-talking telephonic apparatus, embodying an electromagnetically actuated armature mounted on a right-angled arm attached to a mica diaphragm (11). The iron armature (10) is placed between the pole-pieces of two permanent steel mag-



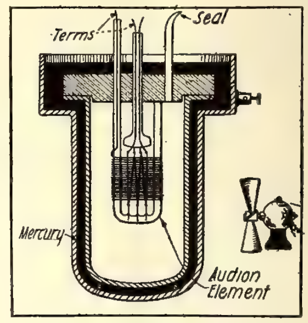
nets 1. The carbon granule microphone of improved design is also mounted in the case as indicated and its electrical terminals lead to binding-posts as well as those of the magnetic coil. This transmitting and reproducing unit is then placed in a large horn as shown at A. Incoming telephonic currents actuate the armature (10) and mica diaphragm (11).

Oscillating Audion

(No. 1,201,271; issued to Lee de Forest.)

Improved means of sealing and conducting heat away from large Audion or Oscillion elements. As shown, the filament, grid and wing of the device are placed within a metal or other container, which rests in a second larger vessel. The space between the two may be filled with mercury, which will effectually seal the interior chamber, permitting a vacuum to be establisht and maintained very efficiently.

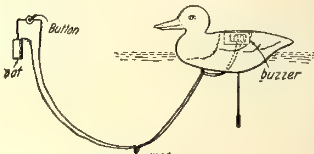
When the vessels are made of metal they may serve as the wing of the Audion.

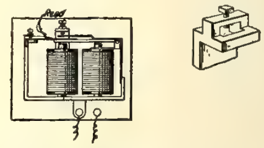


Electric Sounding Device for Decoys

(No. 1,194,018; issued to Fred Vitus Hartner.)

The decoy may be anchored by means of a weight as shown and the lead wires to the battery and push button may be quite long. The pitch of the sound produced by the electric buzzer is variable by means of a tension screw holding the reed, and also by the usual vibrator adjusting screw. Again, the more battery current used, the louder the sound and vice versa.

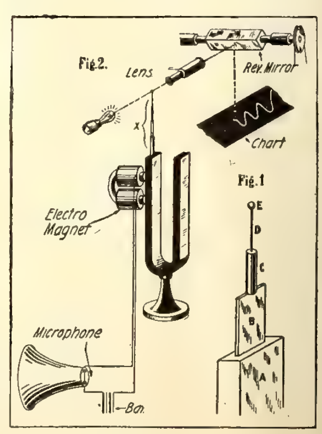




Oscillation and Vibration Recorder

(No. 1,203,172; issued to Alexander Behm.)

This clever invention involves, in one form, the use of a microphone, battery and electromagnet, which, when actuated by sound waves, will cause the tuning fork and associated vibratory member (X) to oscillate at a certain period. The parts A, B, C and D may be made of glass, surmounted by a ball (E) which in vibrating in the path of



an electric light beam directed thru the lens barrel on to a revolving mirror, as shown, will cause a curve to be traced on the chart.

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PHONEY PATENT OFFIZZ

Monthly Prize of $3 for the Best One Submitted

A. MIKE ROBE OF BAKTERIA, N. C.

No. 65 **OTOMATIK FIRE STARTER** **Patent Appaled**

TO WHOM IT MIKE CONCERN:

Be it knowed to all citizens of U.S.A. and other villages, ham-lets & om-lets, as well as outlying planets and asteroids, that, Me and I, assisted by myself, of the illustrious city of Bakteria in the county of Microcokkus, in the State of **N**ervous **C**ollapse have designed, devised and perfected a revolutionary Otomatik Fire Starter, fully hereinafter to be described

It is a fact too well known to deserve further proofs that since the first days of human cyvylysatyon, man, woman or child has had an instinctive horror towards getting up at 5 A.M. in the early forenoon on a cold-gray morning, with the thermometer so low that it sunk out of sight, in order to light the furnace fire.

Divorce courts are full of cases traceable directly to this cause of husbands (or wives) ejected crudely & cruelly from a warm sleep-emporium into a cold, clammy, chilly gray A.M. to no other purpose than to put a match to the kindling.

All these unnecessary unhappyness, as well as cold and rheumatiz producing horrors have been successfully overcome in my new invention, for which a patent is asked for.

This application furthermore cancels my former application No. 68°X2½% N. Lat. pertaining to my "Quarrel-less furnace Starter" where I proposed to have Husband and Wife shake dice in bed, in order to see who had to get up and light the fire.

This idea proved a rank failure, as I ascertained later, for the simple reason that whenever the female wife lost, she immediately discovered a new & plausible disease or illness which successfully prevented her from getting up just then.

The following constitutes a full description of my present invention:

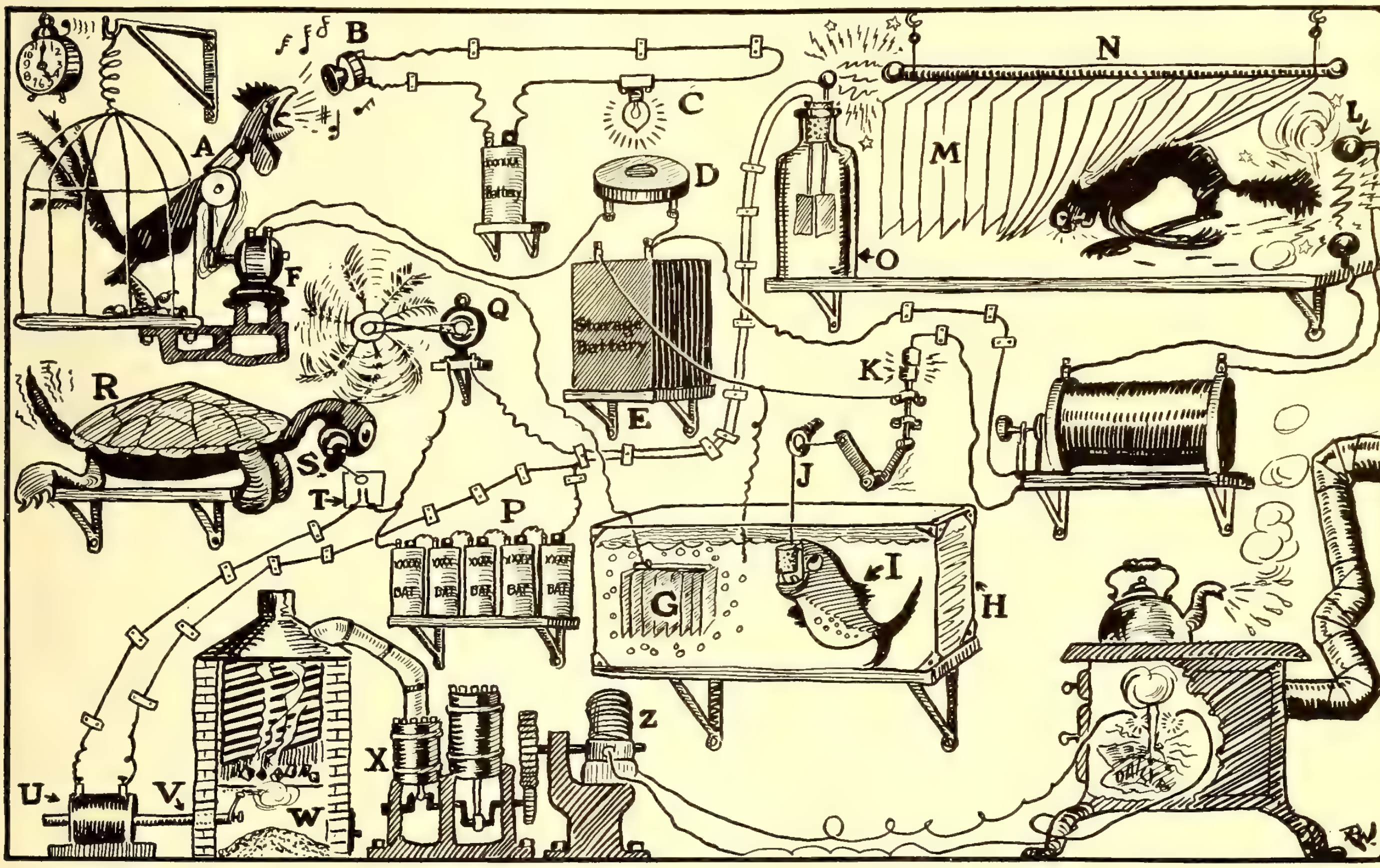
The Bantamoose rooster A, after standing on his corns all night cries with woe in his aching heart at five o'clock sharp. His melodious note affects the microphone B, closing the circuit and lighting lamp C. The light from same operates the Selenium Cell D, causing current from Storage Battery E, to operate motor F, which in turn tightens steel band on rooster's neck and prevents further waste of current in microphone circuit. The reduced current from the motor F, in flowing thru the eight inch platinum plates G, decompose water of aquarium H, containing the rare fish, *Corkfresserus Bitikus,* of South America I. The fish being stimulated by the excess oxygen produced by the current, viciously attacks cork and pulls string J. This operates the switch K, closing Spark Coil circuit. Secondary voltage in relieving itself in spark gap L, awakens cat which has been trained to sleep with tail between electrodes. The cat fearing freezing runs wildly about and under paper sheets M, electrifying same which in turn generates a static current in brass rod N, and thus by inductance operates leaves of electroscope O. This in turn makes batteries P, operate motor Q, whose feathers on shaft tickle snapping turtle R. Snapping turtle gets peevish and bites meat S, thus operating switch T and energizing solenoid U. This draws the rod V, causing match in firebox W to scrape on file and ignite fuel under boiler. As soon as enough steam is generated it works compound Corliss Valve engine X, which in turn runs Webster Magneto Z. Spark from this ignites gasoline soaked paper protruding thru conveniently constructed hole in stove and the fire is lit.

What I claim is:

1° A Painless otomatik Fire Starter.

2° An Otomatik Furnace Starter requiring no male or female profanity for starting it.

3° A Furnace Starter successfully employing all house pets, to keep them in daily trim.



Behold a Most Welcome and Timely Invention, the Electrical Method "De Luxe" for Automatically Lighting the Kitchen Fire These Cold Winter Mornings. It Is Indeed Remarkable for Its Simplicity.

In Fitness whereso off I have heretofore & hereinafter sat down on my seal my hyroglifs from now on unto all other time & forever thereafter, this 39th Night after the 38th day with the barometer at 786% Humidity central time of the year Anno Domino 12 A.C. at 689 Meters Wavelength in the Shade.

A MIKE ROBE
By his Attorney
Jos. Prochasky
Chicago, Ill.

Fitnesses:
Si Multanous
Al Uminnum
Q Kumber

QUESTION BOX

This department is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

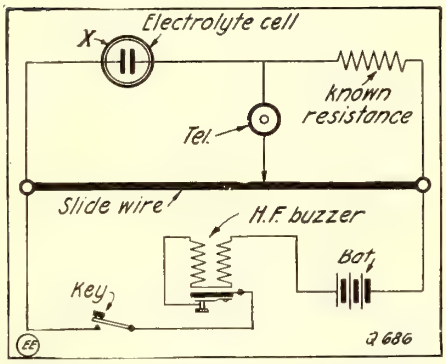
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

RESISTANCE OF ELECTROLYTES.

(686.) P. Jolson, Salem, Oregon, asks:

Q. 1. Please give me a diagram of connections for the measurement of the resistance of electrolytes.

A. 1. The diagram herewith shows the



Using Special Bridge and Buzzer Method for Measuring Resistance of Electrolytes.

connections of a Wheatstone bridge for the measurement of resistance of electrolytes. It should be remembered that when a current flows thru electrolyte it is accompanied by a composition of substance in solution. The positive ions move in the same direction as the current, while the negative ions travel in the opposite direction, each being liberated at the electrodes. In some solutions, this action causes polarization which tends to oppose the flow of current. In order therefore to measure the resistance of an electrolyte, it is necessary to employ an alternating current. It can readily be obtained from a small H. F. buzzer connected as shown herewith.

The electrolyte is placed in a suitable cell and made the fourth arm of a Wheatstone bridge. An induction coil or buzzer is used in place of the usual battery. The resistance of the electrolyte can then be determined by the bridge method in the usual way. Since an alternating current is employed, the balance can be found by means of a telephone receiver connected in the usual place for the galvanometer. For the purpose of instruction the best form of cell for holding the electrolyte is a cylindrical tube with a circular electrode closing each end. The resistance measured by the bridge is then the resistance of the electrodes and knowing the resistance of this column of the electrolyte the resistivity of this solution can be calculated the same as a metallic conductor or is equal to:

$$S = \frac{R \times A}{L}$$

WHERE:—A equals the cross-section of the tube containing the solution and L is the resistance between the two electrodes.

Q. 2. Is it possible to use any other means for exciting the Wheatstone bridge?

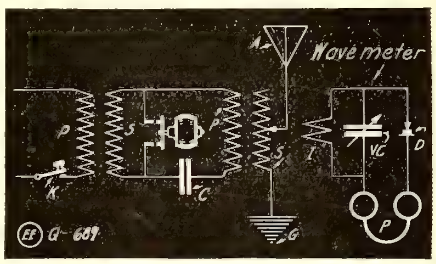
A. 2. You can employ either a buzzer or a high frequency alternator ranging from 500 to 1,000 cycles for excitation.

TUNING OF RADIO TRANSMITTER.

(687.) Edward Law, Jr., Clarksburg, W. Va., desires to know:—

Q. 1. Detail for the use of a hot wire ammeter and wave meter to test a radio set composed of the following: 1 K.W. Clapp-Eastham type "E" transformer giving 4000 volts; condenser composed of 9x12 inch glass plates; rotary spark gap (speed 8000 R.P.M.); oscillation transformer, protective device, key and aerial. Please explain how to tune this station. The aerial is composed of four strands of No. 14 copper wire, 60 feet high and 180 feet long, of the inverted "L" type.

A. 1. In regard to the tuning of your transmitter, and the various pieces of apparatus, the wave meter should be placed according to the diagram given herewith. In tuning the transmitter to a particular wave length, it is necessary at first to set the wave meter at the desired wave length which the set is to emit. Then by exciting the transmitter and at the same time watching the wave meter, the clips of the oscillation transformer are adjusted until the intensity of signal in the wave meter receiver is at maximum. At this point the transmitter is emitting a wave corresponding to the wave meter setting.



How the Wave Meter Is Employed for Checking Up Radio Transmitting Set.

The current intensity of the transmitter is determined by inserting a hot wire ammeter in series with the ground lead as near the earth as possible. By adjusting the coupling of the oscillation transformer, a point is reached where a maximum radiation current is obtained. The hot wire ammeter is generally used for indicating the maximum radiation current.

AERIAL QUERY.

(688.) R. C. Hudson, Minneapolis, Minn., asks the following:—

Q. 1. Would it be better to bring my four aerial leads in, twisted together, direct to the instruments or the four leads in for about 15 feet and then solder them to a No. 8 single copper wire?

A. 1. It is usually advisable to connect the lead-in rattails near the antenna and bring a single lead down to the instruments.

Q. 2. What is the wave length of a four-wire aerial, 100 feet long, 45 feet high, with the wires spaced 2 feet apart?

A. 2. The maximum wave length of your aerial is 260 meters.

Q. 3. How far could I send with the following: A 1 K.W. Thordarson transformer (new type); a rotary gap running at 6,000 R.P.M., an oil-immersed condenser of 1 K.W. size and a Murdock hinged-type oscillation transformer—the whole set being connected with short leads of ¾ inch copper ribbon and operating on the above-mentioned aerial?

A. 3. You should have no trouble in transmitting 150 miles with favorable weather conditions and suitable aerial.

We would also advise you to reduce the speed of your rotary gap as we think the discharge of the condenser might be irregular, due to the high speed of the gap, thus resulting in unsatisfactory results from your transmitter.

RADIO RECEIVING HOOK-UP.

(689.) Verne Van Vlean, Lodi, Cal., desires:

Q. 1. A hook-up for the following instruments: loose coupler; Morehead tube; three variable condensers; fixt condenser and 'phones.

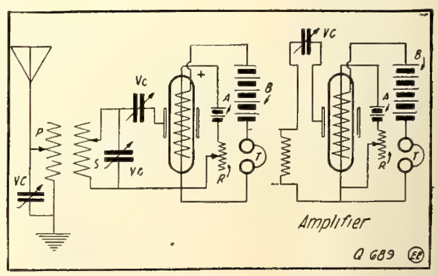
A. 1. The diagram herewith shows the connections for the instruments which you have.

Q. 2. Give hook-up for Morehead tube as an amplifier and state which mineral is best in this arrangement.

A. 2. The diagram herewith gives the connections of the Morehead tube used as an amplifier. We would advise you to employ galena for a detector crystal. It has been stated already in these columns that *Radiocite* crystal gives far better results than any other crystal known and we would advise you to make a test with it.

Q. 3. What is a variometer used for? In which circuit is it most important—sending or receiving?

A. 3. The variometer is an inductive coupling device used for tuning radio sending or receiving sets. It consists usually of two coils, placed one within the other and electrically connected together, the ends of the coils being connected in series with the tuning circuit. Their mutual inductance is variable by changing the position of the inner coil or both. The coefficient of the

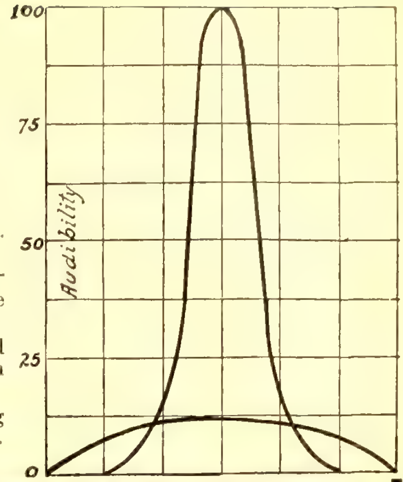


Hook-up for Morehead Tube Used as Radio Amplifier.

coupling of the variometer is very high and for this reason it is very desirable as a tuning device. Practically zero mutual inductance can be obtained with this device.

(*Continued on page 676*)

NOTE THAT PEAK



THE peak is what you get on a RA-6 regenerative receiving set—100 times amplification. The lower curve is the response you get on an ordinary set.

Just imagine the amplification—100 times—and the selectivity is just as great as the amplification. No damping in that peak signal, no interference even if that other station is on the same wave. When you get that peak, you are getting all there is to get out of any incoming signal.

How many times have you had a signal fade out, and tried everything under the sun to hold it just a second or two longer? Then study that peak. Note the difference—see all the strength of signal you have to spare over the strength of signals over an ordinary set.

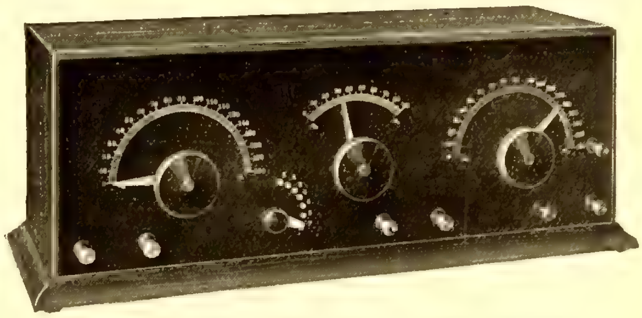
How about the stations you have never heard? Stop worrying because the fellow with the big aerial hears them and you don't. That peak will bring them in. The RA-6 will give you that peak.

This instrument is super-efficient, super-selective and super-sensitive. It was designed especially and solely for reception of **AMATEUR-WAVE LENGTHS** and its development has been carried on over a period of two years. It was the FIRST and is the ONLY worthy adaptation of the Regenerative circuits to short-wave reception. The antenna inductance is arranged in steps. **ASIDE FROM THIS THERE ARE NO SWITCHES.** Continuously variable inductances—carefully designed variometers are used in the closed circuits. **HIGH RESISTANCE CONTACTS, the capacity of switch points and leads, end-turn losses and the necessity for a variable tuning capacity are thus ENTIRELY DONE AWAY WITH.**

The antenna and closed circuits are INDUCTIVELY COUPLED and the COUPLING IS VARIABLE. The component parts of the instrument are not crowded into a small cabinet. The fact that ALL of these things are of extreme importance has been proven by the here-to-fore unheard-of **SELECTIVITY** and **AMPLIFICATION** obtained by owners of this instrument. Signals may be read from stations at extreme distances or through heavy static and interference with this instrument long after other receivers have failed, and WEAK SIGNALS MAY BE AMPLIFIED UP TO **ONE HUNDRED TIMES USING ONE AUDION ONLY.**

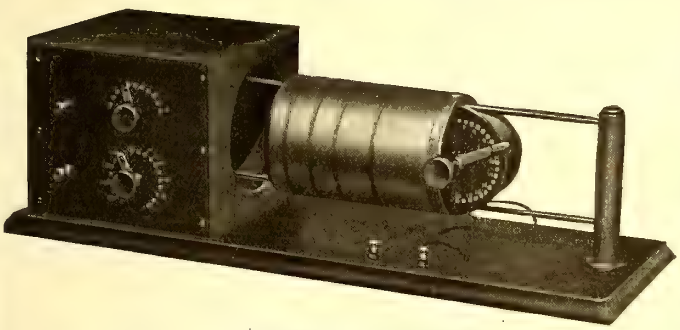
The RA-6, price $35, is as perfect mechanically as it is electrically. It is made right. Everything used in it is the result of long trial and experiment, to make a short-wave set that would give the greatest possible response to any incoming signal, on 180 to 580 meters.

Make that peak work for you ***now.*** Write us ***now.***



R.A.—6—PARAGON AMPLIFYING SHORT-WAVE RECEIVER, $35.00
Range 180 to 580 Meters

PARAGON WIDE RANGE RECEIVING TRANSFORMERS



PARAGON RECEIVING TRANSFORMER
TYPE "L" $22.50 TYPE "S" $30.00 TYPE "X" $35.00

The methods employed in winding the coils eliminate leakage due to coloring matter in the insulation, put an end to the presence of moisture in the varnish, insulation and tube. The coils of the Paragon **"No-End-Loss"** transformers are divided into sections and fitted with **self-cleaning, positive-action** end-turn switches which connect and disconnect the winding as required, **entirely cutting off from the circuit** unused portions of the inductance and **completely eliminating end-turn effects on all wave lengths.** These switches are enclosed and are automatically controlled by the primary and secondary inductance switches respectively.

Panels, housings, switch heads, etc., are of polished black FORMICA, which is superior in every way to hard rubber and costs more. All metal parts are of gold lacquered brass. These instruments are adapted to extremely close tuning and due to the absence of end-losses are particularly recommended as the only receiving transformers on the market suited to the reception of amateur wavelengths or for use in conjunction with the AUDION-DETECTOR.

LOADING COIL
For long wave work $8.00

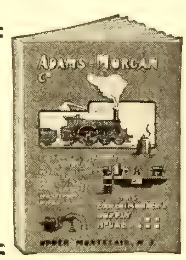
Paragon Instruments Have Set New Standards

They are in a distinct class by themselves. There are no other instruments which can EQUAL THEM IN ANY WAY—regardless of price. WE CAN PROVE THIS ASSERTION TO THE SATISFACTION OF ANYONE.

SEND STAMP TODAY FOR BULLETIN "O" WHICH DESCRIBES A VARIETY OF ENTIRELY NEW TRANSMITTING AND RECEIVING SPECIALTIES OF PARTICULAR INTEREST TO THOSE WHO DESIRE THE BEST.

Send 6c. for our 232 pp. Catalog

Our No. 7 Catalog shows several hundred different parts and also sets of materials for building your own apparatus. We do all the difficult work in our factory and give you the benefit of machinery and equipment.



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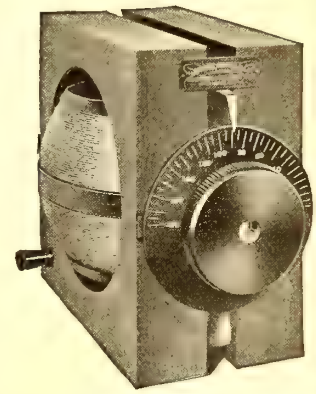


VARIOMETER
Wound for any range. A necessity for the proper tuning of the Audion circuits on short wave lengths. $9.00

Adams-Morgan Co., 13 Alvin Place Upper Montclair, N. J.

QUESTION BOX.

(*Continued from page 674*)

FEDERAL STATIONS.

(690.) E. E. Griffin, San Diego, Cal., inquires:—

Q. 1. Does the Federal Telegraph Company's station at South San Francisco send any press reports with their arc? If so, at what time and on what wave?

A. 1. As far as we know, the station operating at South San Francisco sends press reports, but we are not informed as to the time they transmit. According to latest reports it is said they operate at a continuous stretch during the twenty-four hours. The wave length is 3,000 meters and higher.

Q. 2. At what time and on what wave does the Naval station at San Diego send press on their arc set?

A. 2. The Naval station at San Diego usually sends press at noon on a wave length of 8,000 meters.

Q. 3. Are there any other stations on the Pacific Coast that send press on spark sets besides Marconi?

A. 3. We do not know of any other aside from the Marconi stations.

GENERATOR VOLTAGE FORMULA.

(691.) Alfred Hanson, of Brownsville, Texas, wishes to know:—

Q. 1. A method by which he can calculate the voltage of a magneto generator.

A. 1. The formula herewith gives the means by which you can calculate the voltage generated by your machine.

$$E = \frac{4SVI}{60 \times 10^8}$$

where

E=Voltage

S=Number of conductors on armature

V=Speed of armature in R.P.M.

I=Total flux density in Maxwells (in this case 30 Kilo-Maxwells per pole × two or number of poles).

Q. 2. How would you determine the electro-motive force of a magneto generator which contains 1,760 turns on the armature, and is revolved at 1,200 R.P.M.? The magnetic field was tested by a magneto-mometer instrument and showed an intensity of 60 Kilo-Maxwells. Kindly give proper substitution in the formula if you have any.

A. 2. The solution of the problem is given below:

$$E = \frac{4 \times 1760 \times 1200 \times 60{,}000}{60 \times 10^8}$$

$$E = 84.48 \text{ volts.}$$

Q. 3. What is meant by impedance?

A. 3. Impedance is the total counter effect in an alternating current circuit—that is, it includes resistance and reactance, which latter term includes the capacity reactance and inductive reactance. These three terms when combined have a certain counter or opposing effect upon an alternating current. This total effect is called the impedance. There are several impedance equations which are applicable to different forms of alternating current circuits and we would therefore refer you to some modern text-book on the subject of alternating current listed in our Book Catalog, supplied free.

ALTERNATING CURRENT PROBLEM.

(692.) L. Boyer, Montreal, Canada, states as follows:—

Q. 1. In figuring out the volt-amperes of a three phase, three wire A.C. circuit for the purpose of subsequently calculating the power factor, should three ammeters be used; or is it sufficient to have two ammeters connected in the two outside legs of the circuit only?

(*Continued on page 678*)

AMPLITRON

The New VACUUM DETECTOR AMPLIFIER OSCILLATOR

DESIGNED BY AUDIO TRON ENGINEERS

More Powerful Amplifier, More Persistent Oscillator than the Audio Tron

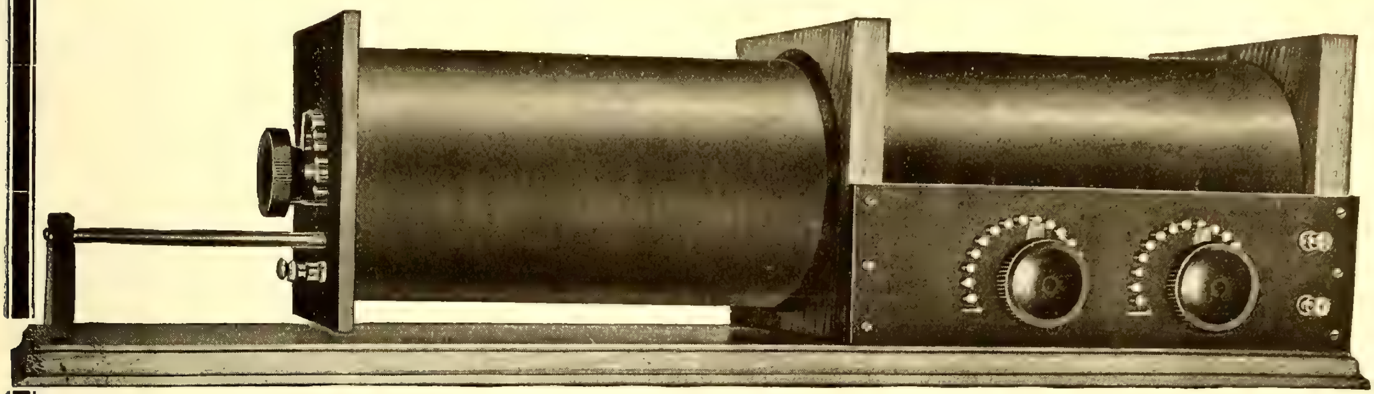
This detector is of the two-member external control type and was originated by Audio Tron Engineers last April. It has been developed and greatly improved since that date. This is its first public offering.

Special Introductory Price **$5.25**

AUDIO TRON ALWAYS OFFERS GREATEST MONEY VALUE WHEN YOU BUY ON SPECIFICATION—NOT ON INDEFINITE DESCRIPTIONS

$32.50 AUDIO TRON 15000 M. ULTRA LOOSE COUPLER **$32.50**

Special Introductory Price on orders mailed before January 1st

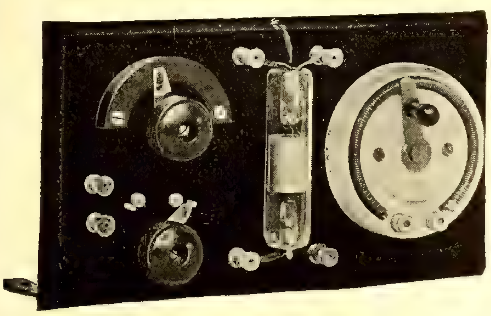


Embodies best features of commercial engineering practice. Quarter sawed oak base and primary ends, secondary end, primary panel and guide support hard rubber. Lathe-turned fiber tubes. No enameled wire used. 16 taps on secondary, 32 on primary. Navy bearing type switches. Large knobs. All metal parts nickeled. Windings covered with black celluloid gives rich appearance and insures protection. Length overall, 36″. Primary ends, 11″ square. Double secondary guide rods. Guaranteed to tune to 15,000 M. The only high-grade long-wave coupler at any price. Regular price **$37.50.**

Orders mailed not later than January 1st will be shipped at these Special Prices:

AUDIO TRON No. 1 Junior Receiving Panel

No. 1 B Panel, Tube and 30 cell sealed B battery	$14.85
No. 1 A Panel and Tube	10.50
No. 1 Panel only	7.00
Parts for Panel only	5.00



Fully Guaranteed.

Shipped prepaid when cash accompanies order.

Maple Panel finished in black imitation Bakelite. Potentiometer Control. All metal parts nickeled. Double Cut-Out Switch. Genuine double filament tested Audio Tron.

Brackets for Table Mounting.

This High Grade Navy Coupler—$14.90

Delivered Free—on orders mailed before January 1st.

Quarter sawed oak, base and primary ends. Secondary end, primary panel and guide support hard rubber.

Metal parts nickeled.

AUDIO TRON Navy Type Coupler, $17.50

Navy type bearing switches. Large knots. Fiber tubes, lathe cut. No enameled wire used. Windings covered with celluloid. Double guide rods. Tunes to 3000 meters.

TERMS: Free Delivery where cash accompanies order. Satisfaction guaranteed.

AUDIO TRON SALES CO., 315 Lick Building, San Francisco, Cal.

SPECIAL OFFERS EXPIRE JAN. 1st

FREE Delivery If You Send Cash With Your Order

QUESTION BOX.
(Continued from page 676)

A. 1. In alternating current circuits where the power factor is to be determined, especially in polyphase circuits, it is usually advisable to have three ammeters connected in the circuit so as to take a simultaneous reading. This is necessary as the current and voltage lag or lead relations in polyphase circuits are of such a character that they may vary in the course of a few seconds or minutes.

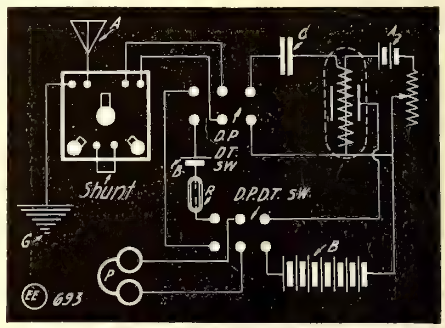
Q. 2. If it should be absolutely necessary that 3 ammeters be used; why is it that with polyphase wattmeters the current from the two outside legs only passes thru the meter?

A. 2. Because in the 3 wire, polyphase circuit of a compensated wattmeter, the coils are so adjusted that the true watts and not the apparent watts are measured. The three voltmeter or three ammeter method is little used in practice as it involves a considerable error unless the constants of the circuit are accurately known and special precaution taken to take the three readings simultaneously.

RADIO QUERY.

(693.) Henry Roberts, Yonkers, N.Y., requests a hook-up for the following apparatus:

Q. 1. An E. I. Co., Vario-Selective coupler, rotary variable condenser, fixt variable condenser, junior fixt condenser, 2000 ohms Transaltantic 'phones and Radioson



Connections for E. I. Co., Vario-Selective Coupler Using Either Radioson or Tubular Audion.

detector, all their make, together with Audiotron bulb detector.

A. 1. The diagram herewith gives connections of instruments which you ask for.

ANTENNA LEAD-IN.

(694.) Beauford Bailey, McAlester, Okla., writes as follows:—

Q. 1. If the leads of a sixty-foot aerial are connected about twenty feet from one end, will two different wave lengths be sent out when transmitting? Or will there be the same effect as if the leads were connected to the center?

A. 1. It is advisable in your case to connect the lead-in rattails at the center, as it may cause annoyance to distant stations due to a harmonic wave resultant from the arrangement which you describe. When we speak of a harmonic wave, we mean a secondary wave emitted by the transmitter in such a way that it will overpower the natural wave of the transmitter, thus causing an annoyance to other stations which is absolutely prohibited by the United States radio law. With a proper quenched Gap set, however, this may be eliminated as the higher harmonic can be distorted by detuning it.

Q. 2. If one cannot have aerial and ground leads both short, would it be better to have a long aerial lead?

A. 2. It is advisable to employ a long aerial lead with a short ground lead.

(Continued on page 680)

QUESTION BOX.

(Continued from page 678)

Q. 3. If the slider on the primary of a loose coupler makes contact with more than one turn of wire at a time, would it have any weakening effect on the incoming signals?

A. 3. Yes, it has a weakening effect upon incoming signals, as a number of turns are short-circuited by the slider.

THE DIFFERENCE AS TO WHO MAKES THE "MISTAKE."

When a PLUMBER makes a mistake he charges twice for it.

When a LAWYER makes a mistake it's just what he wanted, because he has a chance to try the case all over again.

When a CARPENTER makes a mistake, it's just what he expected, because chances are ten to one that he never learned his trade.

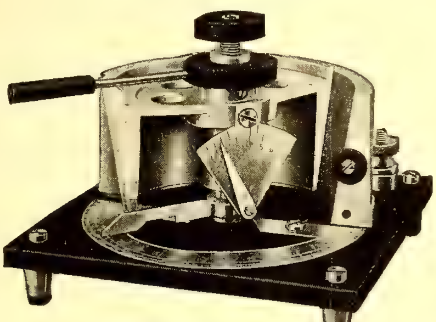
When a DOCTOR makes a mistake, he buries it.

When a JUDGE makes a mistake, it becomes the law of the land.

When a PREACHER makes a mistake, nobody knows the difference.

But when an ELECTRICIAN makes a mistake, he blames it on *induction,* because nobody knows what that is.

THE TURNEY VARIO VARIABLE CONDENSER



Front View

Scale Readings

SCALE 1-0 to .001 M. F.	SCALE 4-0 to .00012 M. F.
" 2-0 to .0005 M. F.	" 5-0 to .00007 M. F.
" 3-0 to .00025 M. F.	" 6-0 to .000055 M. F.

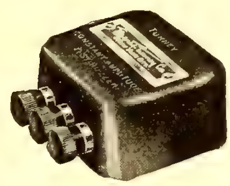
SCALE 7-0 to .000035 M. F.

Dimensions 6x6x3 **Price $10.00**

Shipping Weight 3 lbs.

For extreme measurements such as WAVE METERS, REGENERATIVE CIRCUITS and the like this Condenser has no equal. It is seven complete Condensers in one. It is especially valuable as a grid circuit Condenser. Owing to the sky rocket prices in material and labor we were obliged to increase the price of this instrument to $10. Get our new catalog, it tells all about it.

CONSTANT AMPLITUDE TEST BUZZER



Dimensions 2¼"x 2½" **Price 90 cents**

Postage 10 cents

OVER 12000 SOLD

Our special Constant Amplitude Test Buzzer contains some entirely new features and closely resembles the tone of a 500-cycle Telefunken set. This is due to the arrangement of the contact which is provided with a lenient back-check which prevents the armature from over-reaching and the amplitude becomes constant. This you will find in no other Buzzer. The contact points are of pure silver which prevents burning and the entire mechanism is enclosed in a non-resonant dielectric case. You will never know you have a Buzzer in your circuit as far as attention is concerned. It is provided with three binding posts and is highly finished.

Eugene T. Turney Company, Inc., 2595 Third Avenue NEW YORK CITY

the next relay.

Stations that received the MSG and checked the mistakes are given below. Each credit means that this station checked the mistake from one certain station, and the ones with six, for instance, checked six different stations.

8NH—Mr. and Mrs. C. Candler, St. Marys, Ohio, 6 credits.
9MK—E. H. Giddings, Lanark, Ill., 6 credits.
9DK—D. H. O'Neill, St. Louis, Mo., 5 credits.
9ADT—G. Hartman, Wauwatosa, Wis., 5 credits.
8AEZ—M. B. West, Lima, Ohio, 5 credits.
4DI—W. S. Rothrock, Winston Salem, N.C., 5 credits.
8ALE—Alexander Bros., Grove City, Pa., 4 credits.
9IK—H. G. Mathews, Chicago, 4 credits.
Chester Sinnett, Bailey Island, Me., 3 credits.
9FW—K. B. Warner, Cairo, Ill., 3 credits.
1IZ—R. T. St. James, Great Barrington, Mass., 3 credits.
DK—Kent Bros., Dewitt, Iowa, 3 credits.
9WS—Coy V. Patterson, Kansas City, Mo., 3 credits.
9KF—J. A. Goorisich, Chicago, Ill., 3 credits.
9ACO—E. Wittick, Moline, Ill., 3 credits.
7YS—St. Martin's College, Lacey, Wash., 2 credits.
9RD—F. M. Bailey, Clinton, Iowa, 2 credits.
8CO—H. W. Harmon, Grove City College, Pa., 2 credits.
2ZB—W. L. Brooks, Schenectady, N.Y.
5OX—D. Simmons, Shreveport, La., 2 credits.
7D—H. W. Blagen, Hoquiam, Wash., 2 credits.
3RD—R. Dimling, Baltimore, Md., 2 credits.
9HQ—D. R. Terry, Stoughton, Mich., 2 credits.
6SI—L. L. Hoyt, Hayward, Cal., 1 credit.
3RO—W. T. Gravely, Danville, Va., 1 credit.
1ZF—H. C. Bowen, Fall River, Mass., 1 credit.
9VS—Parker Wiggin, Kansas City, Mo., 1 credit.
3ST—R. R. Chappell, Richmond, Va., 1 credit.
3GX—G. C. Robinson, Richmond, Va., 1 credit.
6PN—Paul Nesbit, Acampo, Cal., 1 credit.
3ZS—C. H. Stewart, St. Davids, Pa., 1 credit.
9YE—W. S. Ezell, Wichita, Kan., 1 credit.

(Continued on page 685)

MULTIFORM RECEIVER JUST PERFECTED BY THE MULTI-AUDI-FONE

The Multiform Receiver is positively the last word in the wireless world. It combines that long looked for receiving set which brings together on a single panel a straight Audion Circuit, the Regenerative Circuit and the Un-Damped Circuit for the reception of long wave stations.

The Multiform Receiver is so constructed that the operator may instantly pass from 150 meters to 15,000 meters by simply throwing a switch, and he may also at his will cause the bulb to oscillate at any point.

With the use of the Multiform Receiver the three Radio functions of the Audion Bulb—Rectification, Amplification and Oscillation—are utilized to their highest possible capacity.

Size 24" x 16" x 12" in mahogany, with Bakelite panel, price............................$100.00.

M.A.F. Short Wave Regenerative Attachment

Our new Multi-Audi-Fone Short Wave Regenerative Attachment is so constructed that you can connect it with your Audion and loose coupler and get those long distance relay messages. Your receiving range will be increased one hundred per cent on a wave range of 150 to 2,800 meters.

Large coils may be added for the reception of un-damped stations.

Our M. A. F. Short Wave Regenerative Attachment is in panel form, built on a genuine Bakelite panel, and the workmanship is of the highest grade throughout.

Size 8"x12" Price $22.50

Buy Your Audions From Us

Send for "Multiform Receiver" and "Regenerative Attachment" Circular

The Best Wireless Christmas Present

The best wireless Christmas present of all wireless instruments is the Multi-Audi-Fone. If you don't believe it read what some of our users say--

R. B. TENNEY says: "Gentlemen:—The Single Step Multi-Audi-Fone is doing wonders and instead of waiting for the few stations I was able to get before I purchased this I can listen in at any time. I can hear dozens of stations I could never hear before. It certainly is all you claim and has made my wireless outfit a double source of pleasure. Yours very truly,
R. B. TENNEY, JR., Waco, Texas."

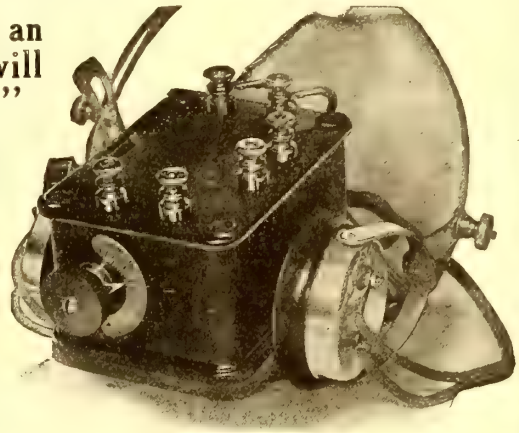
R. C. GIESE says: "The other night I heard Un-damped signals at the end of a one hundred and fifty foot hall and four and one-half stories above my station. We get Arlington or Springfield all over the room day or night.
R. C. GIESE,
Iowa City, Iowa."

"If you ever use an M. A. F. you will always use one."

Multi-Audi-Fone -	$18.00
Two-Step M.A.F. -	75.00
Multiform Receiver	100.00
M. A. F. Detector Stand - - - -	4.25
Pocket Wireless Set	5.75
Detectorfone - -	35.00

Send for Circular

MULTI-AUDI-FONE
275 MORRIS AVENUE
ELIZABETH, N. J.



PRICE, $18.00

TRADE-MARK LENZITE REGISTERED

LENZITE CRYSTAL DETECTOR

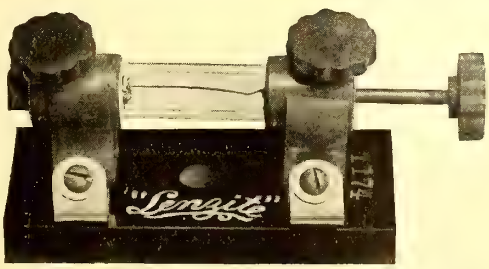
Patented May 2nd, 1916

A first class Wireless Detector is half the battle in the wireless game. Have you tried the best and most effective, **The "Lenzite" Crystal Detector?**

Why Is Our Detector Near Perfection?

1. "Lenzite," the new mineral substance, is acknowledged by leading authorities to be the best substance yet discovered for wireless detectors.
2. "Lenzite" is absolutely superior to any other electrolysis detector combination.
3. "Lenzite" is more economical than most others.
4. "Lenzite" is the most simple detector to manipulate.
5. "Lenzite" is the easiest to adjust and holds the adjustment better.
6. "Lenzite," although not permanent, is the only substance that does not lose its efficiency or effectiveness through excessive charges or excessive heat. In fact, it improves with such treatment.
7. "Lenzite" can be handled like any other crystal, no special care being necessary.
8. "Lenzite" is used exclusively in our detector and comes direct from our mines and is not purchased from different places.
9. "Lenzite" has the endorsement from Q. S. T., the official organ of the American Radio Relay League.

If you want to have a perfect receiving detector, try ours. If not satisfactory, return same within thirty days and we shall be pleased to refund you the price.



Send money order, express order or check for **$5.00** and we will send you, postage prepaid, one of our Lenzite wireless detectors.

LENZITE CRYSTAL CORPORATION
537 Chamber of Commerce Building Pasadena, California

THE PRESIDENTIAL AMATEUR RADIO RELAY.

(*Continued from page 682*)

6AS—Eric Austin, Sacramento, Cal., 1 credit.
2AGJ—J. K. Hewitt, Albany, N.Y., 1 credit.
6WS—W. Ford, San Diego, Cal., 1 credit.
6SR—R. O. Shelton, San Diego, Cal., 1 credit.
IUN—J. W. Peckham, Middleton, R.I., 1 credit.
5DU—B. Emerson, Dallas, Tex., 1 credit.
3WL—R. Davis, Washington, D.C., 1 credit.
6TQ—A. Emerton, Sawtelle, Cal., 1 credit.
3QZ—C. A. Service, Bala, Pa., 1 credit.
9FA—L. A. Walker, St. Joseph, Mo., 1 credit.
8CM—K. Briggs, Rochester, N.Y., 1 credit.
7ZC—A. C. Campbell, Lewiston, Mont., 1 credit.
5CQ—Ray Atkins, Groesbeck, Tex., 1 credit.
9IC—G. A. Greenleaf, Woodstock, Ill., 1 credit.

These stations received the MSG, but forgot to check mistake.

6DM—Robt. Higgy, Phoenix, Ariz.,
IEAA—T. H. Gavin, Fall River, Mass.
8AAK—C. R. Pardridge, Saginaw, Mich.
5BV—J. M. Clayton, Little Rock, Ark.
9TZ—J. A. Gardner, Eureka, S.Dak.
9TZ—E. R. Isaac, Eureka, S.Dak.
9RW—H. J. Pourhop, Sheboygan, Mich.
IDX—S. Sandreuter, Stamford, Conn.
9ZL—Cecil Bridges, Louisville, Ill.
J. T. Moorehead, Greensboro, N.C.
J. N. Simpson, Rochester, N.Y.
R. Ray, Park Rapids, Mich.
F. Jameson, Leavenworth, Kan.
B. Emerson, Monroe City, Mo.
S. D. Daraley, Jacksonville, Ill.
W. L. Galloway, Xenia, Ohio.

There were hundreds of others who merely stated that they had received the MSG and did not state from *what station* and *did not check mistakes.*

The following is the list of sending stations that worked on the relay and also the stations that read them and checked their mistakes:

9XR—heard by 9LP, 9PY, 9NY, 9JT, 9FW, IZF, 9RD, 9WS, 9VS, 9ACO, 9ZL, 9FA, 9IC, 9LW, 8AOZ, 9IK, D.K., 2AGJ, 9KF.

9YA—heard by 9LP, 9MK, 9YE, 9NY, 9JT, 9FW, 5DU, 9RD, 9DK, 9WS, 9ACO, 9FA, 9TZ, 8ACK, 9IC, D.K., 9GY.

9ZS—heard by 9LP, 9PY, 9MK, 9NY, 9JT, 9FW, 8AAK, 9RD, 9WS, 9VS, 9ACO, 9ZL, 9FA, 8NH, 9LW, 9IC, 9ACM, 9IK, 5OX, DK, 2AGJ, 9GY, 9KF.

9IK—heard by 9BJ, 9NY, 3RO, 9JT, 9FW, IZF, 8NH, 9DK, 9ZL, IDX, 8ACK, 3ZS, 9ADT, 9LW, 3RD, 8ALE, 9IC, 9KF.

9ADT—heard by 9IK and 8NH. There seemed to be a fading from this station this night.

7ZS, 7DJ, 7YS. All heard each other and if you will refer to the map you will see what great distances were covered.

9BD—heard by 9MK, 9JT, 9FW, 8NH, 9RD, 9DK, 8ACK, 9LW, IIZ, 9IC.

8JZ—heard by 4DI, 9JT, 9FW, 8NH, 9RD, 8ACK, 8ALE, 5BU, 8CM, 9IK, 2AGJ, 9GY.

8ADE—heard by 8NH and 9IK, but the latter station said that his sigs. were faint.

8SK—heard by 9BJ, 9ADT, 8NH, 8ALE, IIZ, 8ARB, 2ZB, 9IK, 2ALI, 9GY.

9ZF—heard by 9LP, 9ADT, 9MK, 9JT, 9FW, 9RD, 9VS, 7ZC.

8YI—heard by 9BJ, 9LP, 8ALE.

8AEZ—heard by 9BJ, 9LP, 9FA, 3RO, 4DI, 9JT, 9FW, 8NH, IZF, 9MK, 9MY, 9NY, 9RD, 9GY, 9DK, 8AAK, IUN, 3RD, 8CO, 9ADT, 8ALE, 3ST, 3GX, 5BU, IIZ, 9IC, 2ZB, IASI, 9IK, 9ACM, 5CW, 9LW, 8ACK, 2ALI, 4CK, 3QZ, 9HQ, 8QG.

2ZB—heard by 8YI, 8NH, 9RD, 9IC.

9QF—heard by 9LP, 9MK, 9RD, 9VS.

8NH—heard by 9BJ, 9LP, 9NY, 3RO, 4DI, 9MK, 3RD, 8AAK, 9RD, 9DK, 8ALE, 8CO, 8QG, 9IC, 5BU, IIZ, 8ACK, 8AOZ, 9IK, 5CW, 9GY.

9ABD—heard by 9BJ, 9LP, 9ADT, 9MK, 8NH, 8ALE, 4DI, 9RD, 9DK, 8CO, 9IC, 8ACK, 5BU, 8AOZ, 9IK, 5OX, 5CW, 5AA, 9GY.

5DU—heard by 9BJ, 8NH, 9JT, 9FW, 9ADT, 5CQ, 9RD, 9DK, 9VS, 9IC, 6DM, 8ACK, 5BU, 5BV, 5EK, 9IK, 5OX, 5CW, 5AA, 9GY.

9FA—No one reported that they heard these sigs.

6SL—No one reported that these sigs. were heard.

6SH—heard by 9LP, 9ADT, 6AS, 6PN, 6WF, 6SR, 6SL, 7YS.

IATY—9LP claims to have heard this station but did not read his mistake.

9KT—heard by 9LP, 9IC, 9VS.

9IC—heard by 9BJ, 9RD, 9ADT, 9DK, 8CO, 5BV, 9IK, 9LW, 8ALE, 8NH, 8ACK, 9HQ.

9RK—No one reported hearing this station.

9DK—heard by 9ADT, 5BV.

8AOZ—No one reported the sigs. from this station.

8CO—heard by 9BJ, 9DK, 3ST, 3GX, 3RD, 8ALE.

3RD—No one reported this station.

6TQ—heard by 6SH, 6WF, 6SR.

5OX—No one reported the sigs. from this station.

4DI—8ALE and the station on Bailey Island, Maine, as well as lots of local stations and 3GX, 3ST in Richmond, Va., heard this station.

The writer extends his thanks to the three bureaus of information—F. B. Chambers Co., of Philadelphia, Pa.; Illinois Watch Co., of Springfield, Ill., Mr. G. S. Johnson. 6SH—our Western friend, MacQuarrie.

(*Continued on page 687*)

FREE FREE

This Electrical Handy Book and Catalog for Electrical and Wireless Experimenters

FREE With each copy, the splendid 16-page booklet "The Story of the 'Red Head' Receivers," describing the finest Wireless Telegraph Receivers made, selling at only $5.00.

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This is the BIG BOOK you need and want. Describing positively the finest and most complete line of wireless, novelty, and experimental goods ever listed in any catalogue and containing, besides, innumerable tables, hook-ups and treatises of inestimable value to the experimenter.

By actual comparison, the Electro-Set Co.s Handy Book contains more information than *any two* twenty-five cent books on the market. The Handy Book cost $9000.00 to compile. For a limited time we will send this big, valuable book to those interested *absolutely free of charge. Don't even send us postage.* Just write your name and address plainly on a post card, say "I'm interested in your goods."

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Treatises on Wireless Telegraphy; Simple Electric Measurements; A.B.C. of Electricity with many fascinating experiments; Construction of Aerials. *How to Make* Selenium Cells; Calculate Wave Lengths; and Code Charts.

Tables and Data on Transmitting Ranges; Spark Voltages; Inductivity; Weights and Measures; Wave Lengths; Specific Gravity; Resistance; Wire Data; and Spark Coil Construction

HEADQUARTERS FOR WIRELESS GOODS

Big Values at Low Prices in Wireless Goods, Motors, Flashlights, Novelties, Parts, Raw Materials, Wire, Heating Appliances, Lighting Plants, Toys, Train Sets and other goods. Read about our

"Red-Head" Wireless Receivers	Audion Detectors
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$1.00 Telegraph Set	Raw Materials
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THE ELECTRO-SET CO.

ADDRESS DEPT. E-8 CLEVELAND, OHIO

ELECTRICAL THINGS FOR EVERYBODY

RED HEAD WIRELESS RECEIVERS

THE LAST WORD IN SENSITIVENESS

By actual test they are from 10 to 27 points more sensitive than any other standard make. A great New York Testing Engineer reports highly in favor of Red Head Receivers. You take no risk! 5 days' trial—and then if they do not fill every expectation we send your money back.

PRICES

2000 ohms, per pair, complete set, with head band and cord	$5.00
1000 ohms, single receiver only	1.75
1000 ohms, single set, with cord and band	3.00

Send for our Free Booklet before buying wireless receivers

BIG TRIAL OFFER

To "Experimenter" Readers

For the purpose of further introducing our already widely known super-sensitive Triple A Grade Wireless Minerals, we offer for a limited time only this trial size package of A A A

10c **GALENA** postpaid anywhere in the world upon receipt of 10c in stamps or coin

Nearly all serious wireless experimenters are familiar with our wonderful wireless minerals. Hundreds of testimonials prove our contention that **no minerals marketed today can compare in sensitiveness to our standardized grades.** We make an unlimited guarantee that obviates all risk—**Your money back if you are not satisfied.**

Send today for this trial package of Famous Electroset Galena. **If you do not find more sensitive spots in this small trial package than you can get out of 8 oz. of ordinary galena, we will gladly return your dime.**

NOTE: Do not confuse this offer with our regular Arlington Tested Individually Packed Galena at 25c postpaid. Arlington Tested Galena will be sent if requested upon receipt of 25c in stamps or coin. *Arlington Galena is individually tested for extreme distances and is ultra-super-sensitive.*

Send For The Bargain Trial Galena Today

THE PRESIDENTIAL AMATEUR RADIO RELAY.

(*Continued from page 685*)

This was a splendid chance to wish some hard work on them and we feel sure they will have some excuse about serving on the next relay.

If the prize winners will write to the donees of their respective prizes and give them your address you will receive your prize. Refer in your letter to the *Presidential Relay* and the fact that your name is publisht in THE ELECTRICAL EXPERIMENTER. If anyone has any trouble at all write to Cordially yours,

9XE, Davenport, Iowa.

HOW ELECTRICITY HELPS TO MINE AND REFINE GOLD.

(*Continued from page 632*)

not raise the temperature of the water, but they aid in holding it just where it is. It is the same water falling that furnishes the electricity.

At North Fork, thirty miles up the Klondike Valley, one finds the electric plant. The ditch is 30 feet wide, about six feet in depth and *six miles in length!* The water flows down thru the ditch and drops down thru great pipes, with a fall of 220 feet on the turbines, and it keeps the latter moving all the year round.

The principal clearing house in the United States for gold shipments from abroad, such as those sent us by foreign Governments now engaged in the great European war, and amounting to millions upon millions of dollars, is the Government Assay Office, in New York City.

To visit the Assay Office is to bring back the dreams of King Midas and his much hoarded coin. The average person who has never visited this establishment would hardly believe that gold and silver would ever be handled in such an apparently careless manner. There is now more gold stackt around the corridors and strong rooms of the Assay Office in boxes, kegs, bricks and bags than ever before in the history of the country. British sovereigns, packt in boxes are piled up halfway to the ceiling.

Upon entering the doorway to the Assay Office, the visitor, especially if he be a stranger, is met by several armed guards: but once his business is made known, he is treated courteously and finds but little trouble in passing on to the proper departments. But make sure that the attendants at the entrance know exactly from whom you come and just what is your business!

The visitor, as he passes along the corridor, is likely to bump into a stack of 20-franc pieces on one side and a stack of gold bars on the other; and turning to reach the elevator he skirts the outward row of United States gold bars packt five $10,000 bars to the keg, which stretch along the wall twice the height of a man.

The United States Government, of course, is now extremely wealthy, and its purchasing agent for all its vast deposits of gold stored in various sub-treasuries and at Washington is the Assay Office.

The gigantic gold consignments from foreign countries which have been shipt to America in the past two years with which to pay the titanic bills for munitions and other war-time necessities are casht in thru the Assay Office.

More than one quarter of a billion dollars has been released during the past fiscal year and more than $130,000,000 has been received since July last.

For the year ending October 1st the deposits at the Assay Office in New York City amounted to $4.30 per capita for a

population of 100,000,000 people. It is hard to conceive in the mind as to just what these figures mean.

The Assay Office has been fairly swampt with silver and gold, but principally the latter. The predominant specie in the foreign shipments received were British sovereigns and French 20-franc pieces. The largest single deposit made during the past year amounted to $37,500,000, which is "some" shipment to be cared for and guarded all in the space of one day!

The method by which deposits are converted into United States money is as follows: The depositor has mixed bullion of a fineness of 800 thousandths or over, or fine gold. It is brought to the Assay Office, received and weighed and a preliminary assay made by which its approximate value is determined. A receipt is given for the weight found and upon completion of the preliminary assay a check on the Treasurer of the United States may be drawn by the superintendent at his discretion for 90% of its value. The Treasurer places to the credit of the Superintendent, from time to time, such amounts as are necessary to be drawn against. The deposit is then melted, final assay made, and its actual value determined, and a check for the balance, less the charges, is given upon surrender of the original receipt. Final payment is usually made in about five days after the receipt of the deposit. The check is deposited in the usual way or may be immediately casht at the United States Sub-Treasury, in United States gold certificates or gold coin. As the gold certificates go out, their actual value in gold bars is thus deposited in the Government's vaults. The deposit is immediately taken to the melting room of this same department and melted and moulded into bars. This melting process thoroly mixes the metal.

Each deposit is a separate melt. Samples are taken from the molten metal and from these samples the final assays are made and the character of the deposit determined. The weight after melting is the weight that controls in determining value, as low grade deposits lose heavily of their base metals during the melting process, while the loss on fine gold or silver is infinitesimal.

At this after-melting weight the deposit is turned over by the head of this department to the superintendent of the melting and refining department. He, in turn, is charged with the separation and refining of the gold and silver and its being put into the final form of fine gold or silver bars. All metal is refined to a fineness of 999.5 or finer, gold often being refined to 999.9. The superintendant of the melting and refining department in turn verifies on his own scales the weight, and in case of mixed bullion, again in his furnaces melts the deposits and moulds it into *anodes* or short slabs about 18" long and ½" thick, in which the dominant metal is silver. These anodes, in turn, are taken to the silver refining room, and by a special electrolytic process the silver is extracted. This fine (refined) silver is then in the form of coarse silver sand. It, in turn, is again melted and cast into fine bars of various standard sizes.

The residue remaining after the extraction of the silver is in the form of a black, porous, brittle substance, about 900 fine gold. This is again melted, in this same department, and cast into *anodes* or slabs, a little smaller than the previous silver anodes. These are taken to the gold room and by the same marvelous electrolytic process the pure gold is extracted or refined to a fineness of 999.5 or over. This re-

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

ELECTRIC CIGAR LIGHTER.

(118.) W. M. Dennis, Des Moines, Iowa, claims to have invented a small electric cigar lighter so arranged that it can be used in place of a bulb in a pocket flashlight, while a metal cap will protect the clothing if the latter should become short-circuited. Our advice is desired on this invention.

We do not see how this device will work in connection with a pocket flashlight as its current is certainly too weak to bring an electric heater to full glow for use in cigar lighting. Such lighters as a rule consume a lot of current, and for this reason we do not think the device practical.

COMBINATION SWITCH.

(119.) Earl Anderson, Spokane, Wash., has submitted to us drawings and a full description of a device which he calls a combination switch and he wishes to have our advice as to the usefulness and patentability of this article.

This is a very clever article and we think it should fill a decided want. We also think that a patent might be obtained on the article, if some of the lesser details are worked out carefully.

PHONOGRAPH SYNCHRONIZING DEVICE.

(120.) O. S. Wright, Ithaca, N.Y., has written us as follows:

"In your columns of the July issue you state that there is no serviceable device for controlling sound in synchronism with motion pictures. These conditions rather surprise me and I herewith enclose a sketch of a proposed mechanism for controlling a phonograph in connection with the pictures. I have also a proposition for producing the objects on the screen in their original color without resorting to any pigments or other colored moving parts. Both these devices appear very simple and I would consider it a favor to have your criticism on them, both as to their possibility, practicability, novelty and if they are sufficiently meritorious to commend their completion and commercial production."

We have carefully investigated the idea accompanied by drawings and description and have come to the conclusion that this apparatus will probably work as indicated, although we think that the apparatus is somewhat costly and we do not know whether it would work well at all times. We would advise the inventor to have a model built and carefully test it out. If the apparatus works as outlined, we think a valuable property can be developed from it. Our correspondent has also sent in a scheme for producing moving pictures with natural colors. We do not think upon looking this over that it will do what our correspondent claims for it and furthermore we think it would be too costly in its operation. We have come to this conclusion after looking the drawing over carefully, but before entirely condemning it, we would like to see a model in actual working condition.

MARVELS OF MODERN PHYSICS.

(*Continued from page 647*)

switch on point 2 allows the condenser to momentarily discharge, and then it is quickly put on point 3, where the polarizing E. M. F., which is soaking out of the crystal in a direction *opposite* to the applied E. M. F., is balanced against a small difference of potential in the resistance wire a, b. This is repeated several times with different values for "a" and "b," until the potential across a—b exactly balances the polarizing E. M. F. of the crystal. This point can readily be found by means of the quadrant electrometer at QE. This is in circuit with the crystal thru earth connections on both sides, and when no deflection of the needle is noticed, the two currents are in equilibrium. The potential between the points a—b can be readily measured by any means at hand, and this of course is equivalent to the polarizing E. M. F. of the crystal. It is still an unanswered question as to whether the conduction in such a crystal is electrolytic or metallic; that is—whether the molecule really breaks up chemically or whether the electrons move from one molecule to the next, without disturbing the structure of the molecule. It is probably a common idea that an insulator is an absolute non-conductor. The above experiment emphasizes the fact that this is not strictly true, but of course it must be remembered that the current thru the dielectric due to the polarizing E. M. F. is very, very small, and can only be made large enough to detect by an ordinary galvanometer, by heating the crystal to a high temperature. The whole problem of dielectric conduction is important because of the light it sheds not only on condenser phenomena, but also on fundamental questions of physics underlying it. This is a typical modern scientific problem.

It is highly probable that in the not too distant future the old Physics will be discarded, and a new one take its place, based on the rapid growth and meaning of elec-

trical science. Now-a-days the ordinary text-book is divided into sections, treating separately of mechanics, heat, sound, light, magnetism, electricity, and radiation. These divisions are arbitrary and more and more we are coming to see the relations and connecting links between all natural phenomena. Radiation, including heat and light, is electro-magnetic. Magnetism is the product of electricity in motion. Sound is a result of vibration of matter. Mechanics treats of interaction between force and matter, and matter and force both are probably *electrical* in fundamental nature, so the future may see all these topics grouped under a general electrical heading.

At present, scientific progress steadily continues. Mr. C. T. R. Wilson has photographed the paths of both *alpha* and *beta rays*. Prof. Michelson has rendered a distinct service by measuring the length of the standard meter in terms of wave lengths of the red line of cadmium light, to eight significant figures! This gives us an invariable standard. Then by many others research is being carried on in various fields, but the field of radiation seems the most fruitful.

Theoretical progress is the forerunner of practical advance, and last year bigger and better machines were manufactured than ever before, and finer apparatus. The 35,000 kilowatt steam turbo-generator made its first regular commercial appearance. Engines of 100,000 H.P. were installed on the latest dreadnaught. Argon gas was introduced into incandescent lamps, and the use of electrical apparatus has spread from railways to the textile industries, and from mining camps to the farm. Such a wide distribution must indeed offer many opportunities to the man who is trained. Training is the all important factor in success, whether it be derived from the work bench and library at home or whether obtained in the university.

A recent writer on the subject said that the intellectual rise in electricity had reached a final climax when electricity, magnetism, and lightning were identified as one. This was a climax surely, for the old superstitions soon disappeared. No longer was lightning ascribed to the work of evil spirits, and no longer was the magnet used as a charm against disease as by the Rosicrucians. Are we not, however, at the dawn of a new intellectualism, where the meaning of life and nature will become more apparent to us? Already in the last quarter of a century we have discarded many of our old worn-out theories and are assuming new ones that give new meaning to our views of matter, ether, electricity and the universe.

Fate seems to be shaping events now with a view toward making the United States supreme in commerce and industries. So also must she take the lead in science in order to maintain her position. This means added opportunities. In Fig. 3, the path is graphically outlined which leads to success in the greatest branch of engineering, the *electrical*. Erecting, operating and research are the three important fields, and they may be reached by various steps, a few of the more important of which are suggested. No one can evade the apprenticeship whether at home, in school, or in the operating plant. Success in any line awaits the man who is not afraid to work!

[*This is the twelfth and final paper of a series prepared exclusively for "The Electrical Experimenter" by Mr. Rusk.—Ed.*]

An American firm has just been awarded the largest European contract for telephone apparatus and material ever let outside of Europe. It involves a 35,000-subscriber automatic exchange for Christiania, Norway, costing about $1,250,000.

EXPERIMENTAL CHEMISTRY.

(*Continued from page 666*)

composition of water by either Sodium or Potassium are as follows:—

In the case of Sodium,

$$2\,Na + 2\,H_2O = 2\,NaOH + H_2$$

Sodium [Metallic]	Water	Sodium Hydroxid	Hydrogen

In the case of Potassium,

$$2K + 2\,H_2O = 2\,KOH + H_2$$

Potassium [Metallic]	Water	Potassium Hydroxid	Hydrogen

EXPERIMENT NO. 30—

If the apparatus as described in the October issue of THE ELECTRICAL EXPERIMENTER has been made, the preparation of Hydrogen by the Electrolysis of Water is made in the following manner:

Set the delivery tubes in a two-holed rubber stopper as shown by Fig. 25. Next fill the U-tube as shown by Fig. 24 with water, to which a small quantity of Sulfuric acid has been added, in order to conduct the electric current better. Insert the stopper containing the delivery tubes and electrodes and fasten to the ring stand, as shown by Fig. 22. The balance of the apparatus is set up as shown in Fig. 21. Bottles may be used to collect the gas in place of the test tubes as shown.

Attach the wires to the supply of current and watch the changes occurring within the U-tube.

The Hydrogen is collected from the cathode [or negative electrode], while Oxygen is liberated from the anode [or positive electrode].

Apply the splint tests to the gas collected from the cathode electrode in the same manner as in Exp. 23.

Apply the splint tests to the gas collected from the anode electrode in the same manner as in Exp. 17, or any of the Experimental tests for Oxygen.

Certain metals which do not decompose water at ordinary temperatures, or which decompose it slowly, decompose it easily at high temperatures. This is true of iron. If steam be passed through a tube containing pieces of iron filings, or fine bright iron wire heated to redness, the water is decomposed, the Oxygen is retained by the iron in chemical combination, while Hydrogen is liberated

$$3\,Fe + 4\,H_2O = Fe_3O_4 + 4\,H_2$$

Iron	Water	Ferrous Oxid	Hydrogen

When Carbon Monoxid is introduced into Calcium Hydroxid [Ca[OH$_2$] Calcium Carbonate [$CaCO_3$] and Hydrogen are liberated.

$$Ca[OH]_2 + CO = CaCO_3 + H_2$$

Calcium Hydroxid	Carbon Monoxid	Calcium Carbonat	Hydrogen

ACTION OF DETECTORS IN WIRELESS TELEGRAPHY.

(*Continued from page 654*)

line body and some other body permits the passage of electrons more easily in one direction than in the other, this would account for the rectifying effect, and would also account for the thermo-electric effect, provided the velocity of the electrons is suitably different at different temperatures.

7. The thermo-electric explanation of the rectifying effect, if we had found it to be supported by the experiments, would have correlated the phenomenon of rectification at a solid contact with the body of information that we already have in regard to thermo-electricity, but we should still have had by no means a complete knowledge of the action.

8. From experiments with thermo-electricity we are familiar with the fact that the energy of an oscillatory electric current passing thru a high-resistance contact is partially converted into heat energy, and that the heat energy so obtained, if produced at a thermal junction, is again partially converted into electric energy mani-

festing itself as a direct current. It is perhaps, after all, more simple to suppose the alternating current to be converted into direct current without the intermediation of heat; and this seems to be the case with the crystal contact rectifiers. This result opens up a new field for investigation, which may contribute to a better understanding, not only of thermal electricity, but of the much larger question of the mechanism of electrical conductivity in solid bodies.

Under coherers Pierce includes only those detectors which employ a loose contact and require to be shaken, tapt or otherwise moved to restore the contact to its sensitive condition after the receipt of a signal. A great many modifications of the Branly coherer have been made, including the use of a single contact or a few contacts in series or parallel, between metallic balls or points to take the place of the filings.

These various forms of coherer have their importance in the fact that, on the receipt of electric waves, a sufficiently large current is started in the local circuit to operate a relay, ring a bell, or give other form of alarm that can be heard at a distance from the operator's desk. Also the current permitted to flow in the local circuit of the coherers during the receipt of electric waves is sufficiently large to start machinery and control a mechanism (for example, a torpedo or dirigible craft) at a distance. This kind of result is not easily attained with the other forms of detectors, which do not permit of the use of sufficiently large currents in the local circuit to sound an alarm or start electrical machinery. Thus the coherer, though lacking in sensitiveness to feeble waves and not now generally employed in the receipt of messages, has still a distinct field of usefulness.

Besides the filings coherer we shall describe here another interesting form of coherer—that devised in 1902 by Lodge, Muirhead and Robinson. This instrument consists of a small steel disc, rotated vertically by a clockwork, so that the disc is just separated from a column of mercury by a thin film of oil on the surface of the mercury. One electrical contact is made to the wheel thru a brush, and the other connection is made to the mercury well thru a binding post The impulse of the electric oscillations breaks down the oil film and establishes momentary cohesion between the steel disc and the mercury. A current from a local battery passes thru the disc and mercury contact, and operates a siphon recorder, which is used in series with the battery and the coherer. After the impulse ceases, the motion of the disc brings continuously a fresh oil film into the contact and causes de-coherence. The siphon recorder gives a written record of the dots and dashes of the message. A felt brush serves to keep the rotating disc free from dust before and after contact with the mercury.

A generally accepted theory as to the reason for the coherence of the filings, or other form of imperfect contact used in the coherers, has not been establisht. I shall state briefly some of the views presented in explanation of the phenomenon. Before the arrival of the waves, the high resistance of the contact is generally supposed to be due to the presence of some kind of poorly conductive film at the contact. In the case of the Lodge-Muirhead coherer, the insulating film is evidently present in the form of a film of oil. In many of the coherers a poorly conductive film is present in the form of an oxide of the metal. This is evident from the fact that in some cases the metallic particles (*e.g.*, iron or steel) are artificially prepared by oxidizing them in order to make of them a good coherer. The poorly conductive film may also be present in some cases in the

form of a sulfid of the metal. On account of the readiness with which many metals (called the baser metals) enter into combination with the oxygen or sulphur dioxid of the air, a thin film or sulfid is always present on the surface of most of the baser metals, unless special care is taken to remove it.

Apart, however, from the existence of such films of foreign matter at the contact, it seems not impossible that the high resistance before the arrival of the waves may be a property of the surfaces of even pure metals when these surfaces touch only very lightly. If we assume the presence of the poorly conductive film at the contacts of the coherer, we may suppose that, on the arrival of the electric waves, the poorly conductive film is removed by the heat developed by the oscillatory currents. This starts the lôcal current which, developing further heat, still further improves the contact and permits the passage of further current. Instead of heat being the chief agency in removing the oxid or other poorly conductive film, or in bringing together the loose contacts, it may be that this is done by the electric attraction between the filings, which before the current starts will be charged with opposite signs of electricity, and which under the added electromotive force produced by the electric oscillations may attract each other strongly enough to pull the contacts together.

According to the theory advanced by the author, the air film is the essential thing and the oxid film is more or less secondary. The thicker the oxid film is, up to a certain limit, the thicker will be the air film and the higher the voltage necessary to cut down the resistance markedly. That the conducting particles should cohere is not surprising. The only reason why two pieces of the same metal or two pieces of porcelain do not become one piece when pressed together is because of the absorbed air on the surfaces. As Breuer says: "All solids condense on their surfaces certain amounts of gases from the air and hold them with great force. The new surfaces, which are formed when a porcelain plate is broken, are covered instantaneously with particles from the surrounding atmosphere, and these are held in place powerfully as a thin, adherent elastic cushion. The portion of this layer which is next to the porcelain is believed nowadays to be as solid and dense as the porcelain itself, while the outer surface has the density of the air. A simple mechanical pressure, no matter how strong, is therefore not sufficient to bring the porcelain surfaces into intimate contact."

When the air film is removed more or less completely, the solid particles stick to one another more or less tightly and have to be separated by tapping, shaking, or other means. Depending on the conditions of the experiment we may have the oxid films coalescing or the metals themselves. If sufficient energy is expended at the contacts we may have fusion; but this is not a necessary part of the theory. From this point of view the essential difference between the coherer and the crystal detector is that coalescence does not take place readily in the latter case and does in the former. Experiments on welding by pressure give independent confirmation of this fact.

While Robinson gives quite a different theory of the coherer, it only calls for a slight change in the wording of his argument to make it applicable to the theory I have outlined. In connection with the action of the Lodge-Muirhead coherer it is interesting to note that Lenard found, nearly thirty years ago, that mercury "wets" platinum only when a current is flowing.

At other times there is evidently an *air film* present.

Brown superposed an alternating current on a cell, $Zn|H_2SO_4|C$, and found that the polarization was decreased thereby. "By making the surface of the anode in contact with the electrolyte small in area, the action of the alternating current will be concentrated and the ions will be correspondingly increased in chemical activity. In one case the anode was constructed of a fine platinum wire dipping about one-tenth of an inch into the dilute sulphuric acid and an external battery of two volts applied. When the alternating current was superimposed the platinum started to oxidize, and in a short time the whole of the wire in contact with the liquid was turned into a black powder. The same thing happened with gold, the wire turned into a yellow insoluble powder. With the filament of a carbon lamp as anode the carbon was completely dissolved or turned into gas; and, in fact, no conducting material could be found that would resist the combined action of the two currents when applied in this concentrated manner.

CONCLUSIONS.

The general results of the author's researches are:

1. The coherer, the electrolytic detector and the crystal detector act as they do because an electrical stress decreases the thickness of the absorbed gas film and therefore decreases the resistance.

2. The unilateral conductance of the crystal detectors is essential when there is no battery in the local circuit; but it is of no theoretical importance when a battery is used.

3. The essential difference between the coherer and the crystal detector is that coalescence takes place readily in the first case and not in the second.

4. It is not necessary that the oxide film of some coherers should be removed by the current, though this may happen.

5. In the crystal detectors the marked changes in the behavior of adjacent portions of the same crystal face are probably due to localized impurities.

A "NICE" TELEPHONE CENTRAL.

A Subscriber—Give me 789.

Telephone Operator—Seven, eight nine, what central, please?

Subscriber—Oh, any one will do, I'm not particular, those centrals are all nice.—*The Telephone Review.*

THE HOW AND WHY OF RADIO APPARATUS.

(*Continued from page 657*)

or varied by effecting a change in the reluctance of the magnetic circuit of the primary coil. It is possible with this transformer to shunt more or less of the primary flux thru an auxiliary laminated iron branch core X. This branch core may have its magnetic reluctance varied by means of a tapered iron plug as shown, which works on a gear attachment so that it may be inserted more or less into the wedge-shaped gap in the main core. The further this plug is inserted into the gap, the more pronounced the primary self-inductance and the smaller the current consumed, and of course the current in the secondary is also reduced correspondingly. As this iron plug is removed from the gap the primary and the secondary energy increases.

Several years ago there was a very unique and efficient radio transformer brought out and which is shown by the diagram at Fig. 4-B. This closed core transformer was constructed with two projecting laminated iron core legs, X—X, which could be shunted by a movable iron core leg X_1, carrying the auxiliary primary coil, P_1. It will be readily seen that this design provided excellent opportunities for a fine regulation of not only the input and output of the transformer, but also of the general resonance or tuning characteristics.

An adjustable choke coil of suitable proportions connected in the primary circuit of a radio transformer will aid considerably in tuning a complete transformer radio set, as has been found by the Marconi Company; and practically all of their radio sets are equipt with suitable choke coils for this purpose.

One of the leading manufacturers of experimental radio transformers has favored a closed core design with an auxiliary laminated leg as shown at M, in Fig. 4-B. This auxiliary leg is shorter than the coil legs so as to leave a small air gap N. Of course, with this scheme, the transformer, once it is built, is set, so far as its regulation and leakage is concerned, and does not possess the tuning and regulating characteristics that such a transformer as that shown in Fig. 4-A would manifest.

A discussion of the importance of resonance tuning characteristics in radio transformer circuits is given in the work *Wireless Telegraphy* by A. B. Rolfe-Martin. If we insert a variable inductance in the primary circuit of a transformer, we have a ready means of tuning the whole arrangement to any desired period within limits. Furthermore, a suitable inductance in the primary circuit will control the input in the transformer and hence the output as aforementioned, and will prevent arcing across the spark gap in the secondary circuit almost as effectively, if not quite as well, as when choke coils are connected between the secondary terminals and the leads of the oscillatory radio-frequency circuit.

It is well to mention here that all of the best transformer type radio transmitting sets, however, are equipt with light air core choke coils connected to the secondary terminals, which serve to protect the transformer secondary winding from any reflex oscillations or static kick-backs from the condenser helix spark-gap circuit which, in many instances, has resulted in the rupturing of the insulation in the transformer, necessitating its entire rewinding. The primary choke coil, moreover, need not be insulated to withstand the high tension of 15,000 to 20,000 volts produced by the secondary.

There now remains the question of the period that the low or primary frequency circuits are to assume, and they should preferably have the same period as the alternating current supply. If, for instance, we assume that the secondary oscillation condenser has .04 mfd. (4×10^{-8} farad) capacity and a transformation ratio of 20,000: 100 or 200, then, if we desire to design a suitable primary inductance, such that it will give a natural period to the entire low frequency arrangement equal to the period of an alternating current supply having a frequency of 200 cycles, then the time period in seconds would be equal to 1/200th second.

As the time period then of such a system is equal to 1/200 second and substituting the known terms in the time period equation:

$$t = 2\pi T \sqrt{LC}$$

in which T is transformation ratio, we get:—

$$1/200 = 2\pi\, 200 \sqrt{4 \times 10^{-8} \times L}$$

or

$$\sqrt{L} = \frac{1}{16\pi}$$

which gives us a value for L of approximately .0004 henry. This is well within the design limits of a convenient primary choke or impedance coil.

In the design of complete, isolated radio transmitting sets there is one other inductance in the primary transformer circuit—that of the alternator armature; and this somewhat modifies the calculation for exact results. A wiring diagram with adjustable primary choke coil and also secondary terminal, air core chokes is given at Fig. 5, which includes the kick-back preventer, composed of two ½ M.F. condensers shunted by spark gaps and grounded as shown.

NEW WIRELESS LAW PLANNED.

(*Continued from page 671*)

The Secretary of Commerce may upon request determine in advance of the erection of a radio station, on the basis of an application substantially conforming to the requirements of this Section, whether the apparatus to be installed in such station will be licensed upon completion of such station, and upon what condition such license will be granted.

Whoever shall knowingly make any untrue statement in the application for a l ense prescribed by this Section, shall be guilty of perjury and shall be punished by a fine not exceeding two thousand dollars, or by imprisonment for not more than five years or both.

Sec. 9. Station licenses shall be in such form as the Secretary of Commerce shall prescribe and shall contain a statement of the following conditions to which such licenses shall be subject:

1. The station shall at all times be subject to inspection by officials of the Department of Commerce; and the President of the United States, in his discretion, may cause the closing of such station and the removal of all radio apparatus, or may authorize the use of the station or apparatus by any Department of the Government upon just compensation to the owners, as provided in Section 14 (b) of this Act.

2. The ownership or management of the station or apparatus therein shall not change without the consent of the Secretary of Commerce, nor be transferred to an alien or aliens, nor to any foreign government or representative thereof, nor to any company, corporation, or association organized under the laws of a foreign country, or of which any officer, or more than one-third of the directors, are aliens, or of which more than one-third of the capital stock is owned or controlled by aliens or by a foreign government or representative thereof, or by a company, corporation, or association organized under the laws of a foreign country. The ownership or control of more than one-third of the capital stock of any company, corporation, or association to which a station license has been issued shall not be transferred during the term of the license to an alien or aliens, or to a foreign government or representative thereof, or to any company, corporation, or association organized under the laws of a foreign country. No company, corporation or association to which a station license has been issued shall thereafter during the term of the license have any officer who is an alien.

3. The rates to be charged shall be as fixed by the Secretary of Commerce, and shall be specified in the license.

4. Apparatus other than that specified in the license shall not be used for radio communication.

5. Every licensed radio station open to general public correspondence shall be bound to exchange radiograms with any other such station without distinction of the radio systems adopted.

Such license shall also show specifically the ownership and location of the station in which the apparatus is to be used and such other particulars as the Secretary of Commerce may deem necessary for the identification of the apparatus and to enable its range to be estimated, shall show the purpose of the station, the rates authorized by the license, the wave-length or wave-lengths and the decrement or decrements authorized for use by the station, and th hours for which the station is licensed to work.

Sec. 10. Any station license shall be revocable by the Secretary of Commerce, in his discretion, for violation of or failure to observe any of the restrictions and conditions mentioned in the preceding section, or other provision of this Act or regulation of the Secretary of Commerce, and the books and records of the licensee shall be open at all times to inspection by officials of the Department of Commerce to enable them to determine whether such violation or failure to observe has occurred.

Sec. 11. Every radio station for which a station license is required by this Act shall be in charge of or under the supervision of a person to whom an operator's license shall have been issued hereunder. No person shall operate any such station except under and in accordance with an operator's license issued to him by the Secretary of Commerce. The Secretary of Commerce, in his discretion, may grant special temporary li-

censes to operators of radio apparatus when any emergency arises requiring the prompt employment of such an operator. Whoever shall employ any unlicensed person in the operation or supervision of any licensed radio station, or whoever without an operator's license shall operate or supervise such a station, shall be punished by a fine not exceeding one hundred dollars for the first offense, and by a fine not exceeding two hundred dollars or imprisonment for not more than two years, or both, for each offense thereafter.

Sec. 12. An operator's license shall be issued only in response to a written application therefor addrest to the Secretary of Commerce, which shall set forth the name, age, and address of the applicant, date and place of birth, the country of which he is a citizen, and if a naturalized citizen of the United States the date and place of naturalization. The application shall also state the previous experience of applicant in operating radio apparatus and such further facts or information as may be required by the Secretary of Commerce. Every application shall be signed by the applicant upon oath or affirmation. An operator's license shall be issued only to a person who, in the judgment of the Secretary of Commerce, is shown to be proficient in the use and operation of radio apparatus and in the transmission and receipt of radiograms. An operator's license shall not be granted to any alien or representative of a foreign government. Whoever shall knowingly make any untrue statement in an application for an operators license shall be guilty of perjury and shall be punished by a fine not exceeding two thousand dollars or by imprisonment for not more than five years, or both.

Sec. 13. An operator's license shall be in such form as the Secretary of Commerce shall prescribe, and may be suspended by the Secretary of Commerce for a period not exceeding one year, upon proof sufficient to satisfy him that the licensee has violated any provision of this Act or regulation of the Secretary of Commerce, or that he has failed to compel compliance therewith by an unlicensed person in his employ or under his supervision, or the license may be revoked by the Secretary of Commerce upon proof sufficient to satisfy him that the licensee was or is ineligible for a license.

Sec. 14. (a) Radio stations licensed under the provisions of this Act shall at all times be subject to inspection by officials of the Department of Commerce. During any war in which the United States shall be a neutral nation, and in time of threatened or actual war in which the United States may be a party, and in time of public peril or disaster, the President may, by proclamation or Executive Order, issue regulations for the conduct and censorship of all radio stations and radio apparatus of every form and nature within the jurisdiction of the United States. Any person who shall knowingly violate or fail to observe any of said regulations shall be punished by a fine not exceeding ten thousand dollars or by a term of imprisonment of not more than three years or both; and in case of any such violation or failure to observe any of said regulations, the radio station, or apparatus, or both, shall be liable to forfeiture to the United States.

(b) The President, further, in his discretion, may cause the temporary closing of any radio station within the jurisdiction of the United States and the temporary removal therefrom of any radio apparatus for a period or periods of not more than five months each, or may authorize the temporary use of the station of the apparatus thereof by any department of the Government for a like period or periods upon just compensation to the owners.

Sec. 15. (a) Whoever shall maliciously or wilfully interfere with or cause any interference with radio communication carried on or sought to be carried on by any radio station or apparatus shall be punished by a fine not exceeding five hundred dollars for the first offense, and by a fine not exceeding one thousand dollars, for each offense thereafter.

(b) Whoever shall wilfully divulge or publish the contents, substance, purport, effect or meaning of any radiogram, or any part thereof, to any person other than the sender or addressee thereof, or his agent or attorney, except to a telegraph or radio station employed to forward such radiogram to its destination, or in response to a subpoena issued by a court of competent jurisdiction, or on demand of other competent authority, shall be punished by a fine not exceeding five hundred dollars for the first offense, and by a fine not exceeding one thousand dollars, or imprisonment for not more than one year, or both, for each offense thereafter; provided; that this section shall not apply to the divulging or publication of the contents of any radiogram by the sender or addressee thereof.

Sec. 16. All stations shall give priority over all other radiograms to radiograms relating to ships in distress, shall discontinue all sending on hearing a distress signal, and, except when answering or aiding a ship in distress, shall refrain from sending until all radiograms relating to the ship or ships in distress shall have been completed.

Every coastal station and every station whose operation can interfere with the exchange of messages between ship and ship, or ship and coast is required, during the hours it is in operation, to listen in at intervals of not less than 15 minutes, and for a period of not less than 3 minutes, with the receiver tuned to receive messages on a wave-length of 600 meters or such

other normal wave-length as may be required by future international conventions.

Sec. 17. When sending distress signals, the transmitter of a station on shipboard may be tuned to create a maximum of interference with a maximum of radiation. In all other circumstances, all stations shall use the minimum amount of energy necessary to complete any communication.

Every radio station shall use such transmitting apparatus that the energy is radiated in as pure and sharp a wave as practicable, and have a logarithmic decrement not greater than the limits which may be specified by the Department of Commerce, but the owner or operator of a station mentioned in Section 18 following shall not be liable to the penalties provided in Section 28 for a violation of the requirements of this paragraph unless such owner or operator shall have been notified in writing that the transmitter owned or used by him has been found, upon tests conducted by the Government, to be so adjusted as to violate said requirements, and opportunity given such owner or operator to adjust such transmitter so as to conform to said requirements.

Receiving apparatus shall be of such construction and so adjusted and used as to give the greatest practicable protection against interference.

Sec. 18. General amateur stations shall not use a transmitting wave-length exceeding 200 meters or a transformer input exceeding one kilowatt. Restricted amateur stations shall not use a transmitting wave-length exceeding 200 meters or a transformer input exceeding one-half kilowatt. Special amateur stations are permitted to use

(*Continued on page 699*)

any wave-length less than 600 meters and an amount of power not exceeding the limit which shall be specified in the license, provided the Secretary of Commerce is satisfied that such operation would not interfere with Government, commercial, coastal, or ship stations.

Sec. 19. The Secretary of Commerce may, in his discretion, grant licenses to experiment stations to permit the carrying on of tests with any amount of power or any wave-lengths, at such hours and under such conditions as will insure the least interference with the work of other stations.

Sec. 20. Commercial stations and technical and training-school stations shall not use a transmitting wave-length of 1800 meters nor any wave-length exceeding 600 meters unless it exceeds 1600 meters, except in special cases to be determined by the Secretary of Commerce. Such a station shall operate in such a manner as not to cause interference with Government stations or other commercial stations. Such a station shall not use any wave-length between 200 and 600 meters if operation at such a wave-length would in the opinion of the Secretary of Commerce cause interference with coastal or ship stations.

After the passage of this Act no license shall be granted to a commercial station permitting the use of a wave-length between 200 and 4000 meters, except when so far removed from Government or coastal stations that in the opinion of the Secretary of Commerce no interference can occur with Government or coastal communications.

In considering complaints of interference and in deciding whether the license of a station causing serious interference shall be revoked by the Secretary of Commerce, preference shall be given to stations communicating with ships or between points where other means of communication are not available.

Sec. 21. Every coastal station and ship station shall at all times be ready to send and receive messages and signals on such wave-lengths and of such wave character as are required by the existing or future international conventions, one of these wave-lengths to be considered as the normal sending and receiving wave-length of the station. Such stations may also use 1800 meters and such additional wave-lengths less than 600 meters as may be granted by the Secretary of Commerce. Every such station shall have its receiving apparatus so marked that the operator can quickly and conveniently adjust it to a receiving wave-length of 600 meters or other distress wave-length that may be designated by future international conventions.

Sec. 22. No licensed ship radio station when within fifteen nautical miles of a Government land station or a coastal station shall use a transformer input exceeding one kilowatt, nor when within five nautical miles of a Government land station or a coastal station, a transformer input exceeding one-half kilowatt, except for sending distress signals or signals or radiograms relating thereto.

The Secretary of Commerce may regulate or prohibit the use of the transmitters of stations on ship board in harbors within the jurisdiction of the United States, as he may deem necessary.

Sec. 23. No licensed land station in operation on the date of the passage of this Act within fifteen nautical miles from the Government receiving stations at the following points: Boston, Mass., Newport, R.I., Washington, D.C., Charleston, S.C., Key West, Fla., San Juan, P.R., Point Isabel, San Antonio, Laredo and El Paso, Texas, Fort Huachuca, Arizona, San Diego and San Francisco, Calif., North Head, Tatoosh Island and Bremerton, Washington, or from any Government station in Alaska, shall be licensed to change its equipment in any manner that will increase its interference with other stations, and no land station located within fifteen nautical miles of the Government receiving stations herein named, and not in operation on the date of the passage of this Act, shall be licensed for the transmission of public or commercial business by radio communication.

Sec. 24. At all important seaports and at all other places where coastal stations operate in such close proximity to Government stations that interference with the work of the Government stations cannot be otherwise avoided by the enforcement of this Act, such coastal stations as interfere with the receipt of radiograms by the Government stations concerned shall not use their transmitters during the first fifteen minutes of each hour, local standard time. The Secretary of Commerce may, on the recommendation of the Department concerned, designate the station or stations which may be required to observe this division of time. The Government stations for which the above-mentioned division of time may be establisht shall transmit radiograms only during the first fifteen minutes of each hour, local standard time, except in case of radiograms relating to vessels in distress.

Sec. 25. Whoever, including any person in the service of the Government, shall knowingly transmit or publish, or knowingly cause to be transmitted or publisht, any false or fraudulent distress radiogram, or who, when engaged in radio communication, shall transmit or publish, or cause to be transmitted or publisht, any other radiogram for the purpose of defrauding or deceiving the Government, shall be punished by a fine not exceeding two thousand dollars or imprisonment for not more than five years, or both.

Sec. 26. No person shall use or operate any radio apparatus on a foreign ship when within the jurisdiction of the United States otherwise than in accordance with the provisions of Sections 14(a), 15, 16, 17 and 22 of this Act, and all the provisions of said sections and penalties thereto attaching are hereby made applicable to such apparatus: Provided, however, that in no other respect shall anything contained in this Act apply to apparatus on foreign ships, nor shall the restrictions of this Section or of any other Sections of this Act apply to public vessels of foreign governments otherwise than by a general proclamation of the President.

Sec. 27. The office of Director Naval Communications, establisht under the jurisdiction of the Navy Department, shall be charged with the accounting and payment of charges in connection with the settlement of international radio accounts as provided by the London Radiotelegraphic Convention of 1912, or as may be provided by future international conventions. The expenses involved in the settling of international radio accounts, not exceeding five thousand dollars per annum, shall be borne by the United States.

Sec. 28. In all cases of violation of any provision of this Act for which no penalty is otherwise prescribed, or of any regulation of the Secretary of Commerce, the Secretary of Commerce may impose a fine of one hundred dollars upon the owner of the apparatus by means of which such violation was effected, or a fine of twenty-five dollars upon the offending operator, or both, but such fines may be reduced or remitted by the Secretary of Commerce in his discretion; and in addition the Secretary of Commerce may, in his discretion, revoke the station license of such owner and revoke or suspend the license of such operator as provided in Sections 10 and 13 of this Act.

Sec. 29. The Secretary of Commerce shall have power to enforce the provisions of this Act by appropriate regulations through collectors of customs and such other officers as he may designate; and said Secretary shall also enforce

the provisions of such international radio conventions as have been or may hereafter be ratified or adhered to by the United States, except that provisions thereof relating to Government radio installations shall be enforced by the Departments respectively controlling such installations.

The Secretary of Commerce may, upon application therefor, remit or mitigate any fine, penalty, or forfeiture provided for in this Act with the exception of penalties including imprisonment: Provided, that the penalties not involving imprisonment incurred in the Philippine Islands, may be remitted or mitigated by the Governor General and President of the Philippine Commission, and such penalties incurred in the Panama Canal Zone may be remitted or mitigated by the Governor of the Panama Canal on application therefor being made, in such manner and under such regulations as they may deem proper.

Sec. 30. Except as otherwise specifically provided in this Act, the provisions of this Act shall extend to all places subject to the jurisdiction of the United States. The several Courts of First Instance in the Philippine Islands and the District Court of the Canal Zone shall have jurisdiction of offenses under this Act committed within their respective districts, and of conspiracies to commit such offenses as defined by section thirty-seven of the Act to codify, revise, and amend the penal laws of the United States, approved March 4, 1909, and the provisions of said section, for the purposes of this Act, are hereby extended to the Philippine Islands and to the Canal Zone.

Sec. 31. The Act approved August 13, 1912, entitled "An Act to Regulate Radio Communication," is hereby repealed.

Such repeal, however, shall not affect any act done or any right accruing or accrued, or any suit or proceeding had or commenced in any civil cause prior to said repeal, but all liabilities under said laws shall continue and may be enforced in the same manner as if said repeal or modifications had not been made; and all offenses committed, and all penalties, forfeitures or liabilities incurred prior to the taking effect hereof, under any law embraced in, changed, modified, or repealed by this Act, may be prosecuted and punished in the same manner and with the same effect as if this Act had not been past.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The *Very* people, the *Only* people, who could possibly have a use for your things read this journal. More than 75,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers' advertising accepted in Opportunity Exchange Columns only

The rates are: *Three cents per word* (name and address to be counted), minimum space 3 lines. Count about 7 words to the line. *Remittance must accompany all orders.* No advertisement for less than 50c. accepted.

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the February issue should reach us not later than December 25th.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

Subscribers experiencing trouble in dealing with any advertiser should notify the publisher very promptly.

OVER 75,000 PEOPLE READ THIS JOURNAL

WIRELESS set or parts wanted. Have 10 H.P. gas engine, generators, motors, etc. What have you? Give me an offer. Glenn Ely, Dowagiac, Mich.

EMERSON TYPEWRITER, $15; Steward Phonograph, $4; Wireless sending and receiving set, $5; Five pounds No. 28 enameled wire, 50c. pound; Seven pounds No. 11 D.C.C., used, 30c. pound; Luther drill press, $1.50; ½ K.W. open core transformer, $7.50. Send stamp. Joseph Backert, 1015 S. Sixth, Terre Haute, Ind.

FOR SALE—One receiving set, $8. Tunes to 4,000 meters. First money order brings set. Jack Beckton, Caro, Mich.

SALE OR TRADE—$18 Meccano, $8; $3.50 6 v. Dynamo, $2.50; $4 Hand horn, $2.50; Mirrorscope, $1; some sockets; switches, etc. All new. Want Tel-Radion, variables, etc. W. Kinney, 819 Main, Conneaut, Ohio.

FOR SALE—One-half kilowatt transformer and interrupter, price $6. James Butler, 26 Burlington St., Woburn, Mass.

WILL TRADE—600 stamps mounted in International Junior Album and Scott's Standard Catalog for "Brandes Superior Headset" or $5. Telephone Magneto Generator, $1.25; Battery Switchboard, $1.50; 12 Alger Books, $1; Simplex Typewriter No. 1, 85c. Arvine Day, 122 Hartson St., Syracuse, N.Y.

WHAT AM I OFFERED for a complete receiving set completed of $1 Murdock Fixed Condenser, $7.50 Murdock 2,000 Ohm Phones, $25 Blitzen Receiving Transformer, two $4 each Blitzen Variable Condensers, $2 Loading Coil, two $5 each Ferron Detectors and Silicon free? A polished Mahogany Cabinet free. First offer takes it all. All letters answered. Mr. Reuben Topplestein, 90 Williams St., Chelsea, Mass.

FOR SALE—Complete two-step Multi-Audi-Fone with horn, $45; only used two weeks, seals unbroken. Mrs. Addie Mapes, Carlisle, Pa.

FIRST $2.50 takes 1-inch E. I. Co.'s Spark Coil. In good condition. Wolf Farsen, 212 Brighton St., Tottenville, N.Y.

FOR SALE—Goodell-Pratt speed lathe, seven-inch swing, twelve inches between centers, complete attachments for wood and metal turning. One Emerson A.C. induction motor one-tenth H.P. Also wood working tools all descriptions. No trades considered. A. C. Fisher, 307 West Fayette St., Cumberland, Md.

EXCHANGE—1/10 H.P. D.C. Motor and 4 bar magneto, 6 v. 2 amperes. Want Crystaloi B.B., Mignon RCI or Tel-Radion. D. Gadberry, Wilmington, Ill.

FOR SALE—Complete wireless receiving and sending set with aerial complete. Good sending and receiving range. A low price will be made for prompt acceptance of offer. Apply telephone Yonkers 1541. Geo. B. Tripp, 30 Edgecliff Terrace, Yonkers, N.Y.

WANTED—Electro "Vario Selective Coupler" (Cabinet Type), also good crystal detector. C. Ehrenberger, 4151 W. 31st St., Chicago, Ill.

WILL TRADE—$150 portrait camera and outfit and $45 I have paid on any I.C.S. course, for receiving set of about same value. Jack F. Manning, 636 61st St., West Allis, Wis.

WANTED—Wave Meter. State make, condition and price. W. O. Watkins, Birmingham Laundry Company, Birmingham, Ala.

SACRIFICE—First $10 gets Cabinet Type Receiving Set with 2,000 Ohm Phones and 6 v. Storage Battery. Cost $17.50. NEVER USED. 100 Ft. Aerial Wire given free. Leo Shearer, 15 Madison St., Latrobe, Pa.

FOR SALE—One 4,000 meter loading inductance for oscillating Audion circuits. Price $3. Edward Law, Jr., 216 Sycamore St., Clarksburg, W.Va.

BARGAIN—Transcontinental set, magneto, 4 Edisons, $16. New F.C. Tel-Radion, $14. LeRoy Daniels, Litchfield, Mich.

FOR SALE—Complete Sending-Receiving Set, 3,000 meters, 5-8 miles, $20. Commercial precision wavemeter Condenser, high capacity (0.006 M.F.), cost $65, will sell cheap. A1 condition. Ask for description. Wanted: Blitzen Receiving Transformer. Vandell, 129 Baltic St., Brooklyn, N.Y.

FOR SALE—Receiving and Sending Set consisting of loose coupler, loading coil, condenser, Tel-Radion detector, buzzer, 2,000 ohm phones. Spark coil, condensers, step-down transformer, helix, key. First money order for $15 takes it. R. A. Ruble, Centralia, Wash.

FOR SALE—Telegraph Sounder and Key, $1.25; baseball game, $1.15; 5 toy motors, 50c. up; $8 Radioptican, $3.35; $5 BS micrometer caliper, $2; Graphophone, 100 records, $10; H. Smith, 99 Bentley Avenue, Jersey City, N.J.

RESULTS!

Matoon, Illinois.
November 21st, 1916.

Dear Sirs:

Got to give it to the "E. E." ads, as they sure are THERE when it comes to penetrative WORK....... and we are enclosing ANOTHER ad which please insert in the January issue of the Opportunity Exchange.

Yours very truly,
Mid-West Wireless Mfg. & Supply Co.

Try Them Yourself

FOR SALE—Complete receiving outfit (loose coupler and variable condensers) and 2-inch sending outfit for $12. F. Kahmer, Annapolis Jct., Md.

FOR SALE—$40 course in Taxidermy (40 lessons), one-fourth price, $10. Oliver No. 3 typewriter, $23. Joseph Berg, Hendrum, Minn.

FOR SALE CHEAP—Pierce four-cylinder two-speed shaft drive motorcycle in good running order; nearly new Steffey Bicycle Motor Attachment; New Post Card Kodak. Donald Clark, De Witt, Mich.

BRAND NEW one-minute Post Card Camera, also Telegraph, Ivers Johnson .32 Revolver, Motor, etc. All for good printing press outfit. B. Swanson, Pierson, Fla.

FOR SALE—2,000 ohm headset, $3.75; 6-60 storage battery, $2; Blitzen 43 plate variable parts less case, $3; 0-5 Hotwire ammeter, $3.75; ¾ K.W. Thordarson with kickback preventer, $14.75. Robert C. Bishop, Locust St., Lockport, N.Y.

FOR SALE OR EXCHANGE—Remington Typewriter for two Audiotron Bulbs and long wave inductances or $10 cash. Have one-cylinder 1903 Oldsmobile Auto, may be converted into cycle-car, will trade for ½ K.W. Transformer and Condenser or equal value. Jack Hardy, Littleton, Mass.

FOR SALE—E. I. Co.'s "Government" Receivers, $6.75; E. I. Co.'s ½ K.W. Open Core Transformer, $6.25. Money order brings either. Raymond Phelps, Caro, Mich.

A BARGAIN—Excellent 2 K.W. Rotary Gap. Make an offer. Thomas McCann, 115 N. Perry St., Dayton, Ohio.

GOING TO MOVE—Must sell. Crystaloi Type AA, $4, NAA tested; Spark Gap, 50c.; Key, 50c.; 3,500 m. Coupler (Walnut), $5; 3 80-ft. lengths Aerial Wire, 75c.; 1-inch Spark Coil, $3. W. N. Curry, Sweet Springs, Mo.

FOR SALE—$15 Draftsman's Outfit; 7 volume Cyclopedia Applied Electricity; Bell Ringing Transformer, 5 bar Magneto, Wright model Aeroplane, Bicycle Lamp, Cyclometer, Ice Skates, Tools, Camera Supplies, Puzzles. Will buy or exchange for Omnigraph, No. 2. George Paetz, 76 Pilling St., Brooklyn, N.Y.

WANTED—Murdock Oscillation Transformer and Moulded Transmitting Condensers. Give particulars. Wm. Rauft, 4107 Belle Ave., Baltimore, Md.

KODAK FILM TANK—Size 3½-inch, cost $5.50. Want a good Spark Coil. Joyce McLemore, Wise, Va.

FOR SALE—Long distance receiving set consisting of: Navy type loose coupler, De Forest audion with new bulb, 3,000 H.C. new head set, variable Murdock condenser and Duplex loading coil. Cost over $50, sell for $27. Orland Ormsby, Douglas, Wyo.

FOR SALE OR EXCHANGE—Ultraudion and new tubular bulb, $15; three-inch spark coil with independent interrupter, $12; two intensifying coils for use with audions, cost $11 each, will sell for $7 each; Ferron detector, $2; Brandes Transatlantic Phones, $6. All guaranteed perfect. Orland Ormsby, Douglas, Wyo.

WILL EXCHANGE—Excellent .22 Stevens rifle for head set of not less than 2,000 ohms; self-filling fountain pen for variable condenser; carbide tank off Ford for Universal detector; 2 H.P. motorcycle engine for ⅛ H.P., 32 v. dynamo motor. Wilkes Dearing, Covington, Tenn., R. 2.

FOR SALE—Attractive Receiving Set, Audion Cabinet and Navy Type Coupler mounted together. Bulb and B. batteries nearly new Bakelite front, all in good condition. Worth $40. Sell for $20. Multi-Audi-Fone with three year guarantee for $12. Send for photograph of set. John Adams, 5424 Fulton St., Chicago, Ill.

LISTEN—Will trade good sound 110 volt A.C. fan motor, for good two filament Auditron bulb. Must be in good condition. Arthur Fakler, 422 So. Baker, Winona, Minn.

FOR SALE—$15 Thordarson transformer, $10; $6.75 Oscillation transformer, $4; $3 key, $1.75; 2 Aerial Switches, $1.75 each; $13 Rotary, $8; Lightning Switch, $2.75; $15 Coupler, $10; $4 Variable, $2.75; 2 Loading Coils, $2.75 each; Holtzer Cabot Phones, $5; Panel Audion, $12; Panel Audio Tron for damped and undamped waves, $18; $25 Audion, $16; Audion Case, $3; Crystal Detector, $1; $2.50 Fixed Condenser, $1; New Visible Typewriter, $15. Raymond Schlegel, 1118 N. Negley Ave., Pittsburgh, Pa.

FOR SALE—Complete Edison Moving Picture Machine, cost new $200. Will sell for $50. Moving Picture Film, 50 feet or more, one cent per foot. Herman David, 711 South Kedzie Ave., Chicago, Ill.

SELLING—Seneca (4x5) plate camera and outfit, $15. Cost $20. Write for particulars. Eric Peters, Pennsgrove, N.J.

KODAK and complete finishing and enlarging outfit. Sell for $13 or trade for double-barrel hammerless shot gun. Write J. K. Brennan, Eolia, Mo.

FOR SALE—$10 Meccano slightly used and spring motor. Will trade for wireless goods. Make me an offer. Glenn Mooberry, Dorchester, Neb.

LARGE "20,000" meter Loose Coupler. Hear "OUI" and all spark stations. Will take $12. All letters answered. C. H. Severance, Plymouth, N.H.

SALE OR EXCHANGE—4 vols. Power Book Library, Power of Will, Culture of Courage, Business Power, Power for Success, cost $20. Ansco vest pocket camera, cost $7.50. Other books and motors. Want head set and receiving instruments. Write M. L. Richard, Monroe, La.

SALE OR EXCHANGE—$30 1/3 H.P. Westinghouse Motor, $25; $48 Bench Lathe, complete, $35; $7 D.C. Generator, $5. Articles in perfect condition. Want Ford Motor complete in perfect condition. Stamp for descriptions. H. E. Neefe, La Farge, Wis.

RECEIVING SET complete with mineral, mounted on base without phones, $6. William R. Ring, 5920 Wellesley Ave., Pittsburgh, Pa.

CONLEY CAMERA 5x7. Good condition, Rectilinear lens. Revolving back, tripod, five plate holders and carrying case. Also two stereoscopes with Underwood & Underwood views, 55 of Vatican and 100 of Palestine with guide books. Outfits never used and worth $28. Will exchange any or all for standard wireless instruments or sell at a bargain. Francis A. Theado, 11 N. Market St., Petersburg, Va.

FOR SALE—Receiving set, gets Arlington, using indoor aerial, $8. Money order brings it. Raymond Phelps, Caro, Mich.

SALE OR EXCHANGE—United Wireless Carborundum Detector, 75c.; Buzzer, 20c.; 20 ohm Sounder, $1; 160 ohm Relay, $2. All new. Want Murdock 55 or Brandes Phones. J. Smith, Trout Run, Pa.

FOR SALE—Vest pocket camera, $3; Post card camera, $8; 4x5 Plate camera and outfit, $6. (Write) L. A. Madison, Kingman, Me.

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the February issue should reach us not later than December 25.

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THOUSANDS MEN AND WOMEN, 18 or over, wanted for U.S. Government Life Jobs. Thousands 1917 Vacancies. $75.00 month. Steady work. Short hours. Rapid advancement. Common education sufficient. Write immediately for list of positions easily obtainable. Franklin Institute, Dept. S 27, Rochester, N.Y.

MISCELLANEOUS

AGENTS—$42.00 weekly easily made selling our new household articles. Sells everywhere. Samples free. Berg Company, Dept. C12, Hendrum, Minn.

BOYS—START A SMALL MANUFACTURING BUSINESS of your own making our poultry fountains from finished materials easily obtained. Profits limited only by your own ambition. Complete instructions 25c. postpaid. See our ad American Poultry Journal. The Clark Co., 11 Barnes Rd., Newton, Mass.

EVERYBODY WANTS IT—Folding Pocket Coat and Hat Holder. Can attach anywhere and remove instantly, nickel plated. Sample 10c. Big seller for agents. Wedge Mfg. Co., "Km" Binghamton, N.Y.

FOR SACRIFICE SALE—Six electric stoves or toasters never used. Fine Christmas presents. $1 each prepaid. Richard Gaillard, Pendleton St., Columbia, S.C.

KEY RING TAGS made of metal with name and address engraved on them, 25c. each. Humphreys, 33 Friendship, Providence, R.I.

LEARN SHOW CARD Lettering and Sign Painting by our quick, low priced method and be independent. Earn from $18 to $50 per week. The most interesting and best paying trade in the country. Useful in any line. Full particulars free. Providence School of Lettering, 21 East St., Providence, R.I.

STAMPS—75 all different free. Postage 2c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

MARCONI—We have a limited number of pictures of Guglielmo Marconi that are done in sepia on fine India paper. Fine for decorating your wireless room. Ten cents each postpaid. Experimenter Publishing Co., 233 Fulton St., New York City.

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WIRELESS

A FEW MORE TRONS left complete with potentiometers, $4.30; "R.A.C." Hytone rotaries, $9.00; Transatlantic couplers, $4.25; Sayville couplers, $13.00; Multi-Audi-Fones, $15.50; expert lathe work, raw material, books. Let us quote you on that instrument—OUR GUARANTEE STANDS THE TEST—Watch for our bargains. Mid-West Wireless Mfg. & Supply Co., Mattoon, Ill.

RADIO QUESTIONS answered 5c. each; 3 for 10c. Walter Patch, Ventura, Iowa.

AMATEURS ATTENTION—We will buy, sell or exchange your Wireless material. Write us for details, stating your case fully. Be fair to yourself, give us a trial. The Hartford Radio Apparatus Co., Box 755, Hartford, Conn.

AMATEUR EXPERIMENTERS—Send ten cents for our new chart showing how to get efficiency in your closed oscillating circuit at all powers. Send red stamp for our literature anyway. Benson & Benson, Lawrence & Somerset, Philadelphia.

AUDIONS—New round two filament De Forest Audion and Amplifier Bulbs. Cahn, 746 Greene Ave., Brooklyn, N.Y.

COUPLERS—Variometers, Condensers, etc., built to order. Meters, Motors and Generators repaired. Transformers built. Let us know your wants. Oakes Mfg. Co., Rear 546 Alter St., Hazleton, Pa.

EXPERIMENTAL WORK and apparatus made to order, have small lathe, take anything in exchange or give lowest price. J. F. Young, 1938 Federal St., Philadelphia, Pa.

ELECTRICIANS—Send 50c. for 10 Blue Prints of Motor and Generator Connections. 28 for $1.00, 10 A.C., 4 D.C. Motor Winding Diagrams for $1.00 or 20 A.C., 4 D.C. and 4 Rotary Converter Drawings, $1.60. Winding made easy. Martin Electric Co., 329 Irvington Pl., Denver, Colo.

ELECTRON RELAY BULBS, 2 filament, new. Satisfaction guaranteed. $4.35, postpaid. R. J. Nichols, Midland, Mich.

FOR SALE—A few secondary coils for wireless transformers up to 1 K.W. Also cores of best grade steel. R. J. Coats, 824 Clinton St., Ft. Wayne, Ind.

BUILD YOUR OWN TRANSFORMER. We can supply you with secondary coils and cores for transformers up to 1 K.W. Ft. Wayne Transformer Co., North American Bldg., Ft. Wayne, Ind.

FOR SALE—Wireless Transformers. Bargains. A. R. Darling, 56 N. Bradley Ave., Indianapolis, Ind.

$3.00 Toy Transformers, $1.60. Only a few left. Folders sent free. A. R. Darling, 56 N. Bradley Ave., Indianapolis, Ind.

NAVY TYPE COUPLER and loading coil combined, $12.00; 2,500 meter coupler, $5.00; other bargains. Cliff Mfg. Co., Brookfield, Mass.

NAVY TYPE COUPLER—Genuine mahogany woodwork, Primary varied by 2 ten-point switches on a hard rubber panel. Wound with silk covered wire. Special price, $5.00. Cabinet and Special Panel Sets. Send 2c. for circular. K & P Radio Apparatus Co., 1062 Franklin Ave., Bronx, New York.

SOME FIRST CLASS wireless apparatus at fair prices. Post card will bring particulars. George Grossman, Box No. 194, Columbia, Mo.

TELEGRAPHY—Morse and Wireless—also Station Agency taught. Graduates assisted. Cheap expense—easily learned. Largest school—established 42 years. Correspondence courses also. Catalog Free. Dodge's Institute, Lone St., Valparaiso, Ind.

UNUSUAL BARGAIN—Rotary Converter operating on 110 volts D.C. and having an output of 85 volts, 11 amperes, at 60 cycles. Operates ½ K.W. transformer perfectly. Is unusually small; size 8½x9x11 inches; weight 64 lbs. Has regulating rheostat 12x13x6 inches weighing 29 lbs. and is an ideal equipment for experimental purposes. Price complete, $35.00. Electro Importing, 236 Fulton St., New York City.

The Electrical Experimenter

233 Fulton Street, New York.

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Tapping the Earth's Heat

AS the world progresses, it becomes more and more apparent to students of economics, as well as to the layman, how utterly inefficient and archaic our present coal-burning practise is. There is certainly no greater anomaly than our present coal age, and we may be quite sure that our great-grandchildren will read with amazement how supposedly intelligent people the world over were using such an expensive make-shift as coal.

There is an excuse for the steel manufacturer using coal when he can mine it at his door. But there is no excuse for a manufacturer or a householder using coal a thousand miles or more distant from the mines. It is simply our present lack of knowledge as well as our gross inefficiency that makes such things possible. First, we mine the coal, compelling men, who could be employed to vastly better purposes, to be imprisoned for life within the bowels of the earth. Then we re-handle the coal a dozen times before we load it on trains. Then we haul it over unbelieveable distances, burning more coal in locomotives as we go along. Then, if there is no rail blockade, just at the time when coal is needed most, we dump it into someone's yard a thousand miles away from the mine. Next, we load it once more and then sell it to a jobber and he in turn dumps it into another yard. He too sells it again to a dealer who dumps it into his own yard. The dealer, after he kept it long enough, loads it once more and he also dumps it again, this time into the bins of the ultimate victim. In the meanwhile the coal has been rolling up an avalanche of profits and interest as well as extraordinary expenses in foolish transportation and re-transportation. So at the end of the tortuous road, coal worth $3.00 a ton at the mine, now sells for $7.00 and even $12.00 a ton! It speaks well for us.

But this does not finish the story by any means. After re-handling it a few more times, we now burn the coal and while we do get a little expensive heat, we vitiate the air, poison our lungs, make no end of dust and finally we must dump the burned coal—ashes—once more. And removing ashes costs additional money. Whence we remove ourselves to our library and read the latest magazine which tells us what a wonderfully enlightened race we are. This makes us feel real proud of ourselves.

Of course, happy to relate, the whole world is not peopled by fools. We are slowly beginning to realize that there are other things to give us heat, light and power besides coal. First and foremost we have "white coal"—our waterpower. It costs less to transport horse power by wire than by rail. Thus enlightened Syracuse runs its electric street cars by the power obtained from Niagara Falls, 150 miles distant. And of late the great Chicago, Milwaukee and St. Paul Railroad runs all its electric trains over a distance of 440 miles—not by coal, but by waterpower translated into electricity and led over thin wires along the tracks of the railroad.

But waterpower plants are comparatively scarce. Soon there will not be an untapt waterfall which is not working to full capacity. What then? Our answer comes from Italy. And this time the answer is not visionary, or an editorial pipe dream either. For Prince Ginori-Conti now has a huge power plant located in a volcanic region, which gives him 15,000 horse power every second of the day as well as during the night. He simply taps the heat of our earth by sinking pipes five hundred feet underground and by this natural heat costing nothing, he obtains heat for his boilers which in turn drive the electric turbo-generators.

What he can do anyone can do at *any* point of the globe. True his conditions are favorable, for he did not need to sink his pipes very deep. But great depths are no obstacles to a good engineer to-day.

Speaking generally if we drill a hole straight down into the earth the heat increases 1° Fahrenheit for every 40-50 feet. This means that under adverse conditions we must sink our pipes from 8,000 to 9,000 feet before we will reach a level where we strike 212° Fahrenheit, at which temperature water changes into steam. Huge as such a depth is, as well as huge the cost to reach it, it is not unpractical. Remember it needs to be done only once; after that we will enjoy free power for centuries to come. Moreover, in many localities 212° will be reached at a depth of less than 2,000 feet. In exceptional localities such as Yellowstone Park, boiling water comes to the surface while in volcanic regions a few hundred feet is sufficient to sink our pipes.

Would it not pay municipalities to tap the earth's heat under foot and supply the city with heat, light and power at a good profit? Steam heat could be supplied to factories and householders for heating purposes at a low cost by running steam pipes underground. This, by the way, is quite practical altho not widely known. In New York, for instance, one large corporation supplies steam heat to consumers over an area of approximately 1½ miles square (2¼ square miles) thru fifteen miles of steam mains, but of course the heat is now obtained by burning coal first.

Our big states lacking coal and waterpower should certainly waste no time in trying Prince Ginori-Conti's plan. Such terrestrial heat plants will pay for themselves in two years or less.

H. GERNSBACK.

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THE ELECTRICAL EXPERIMENTER

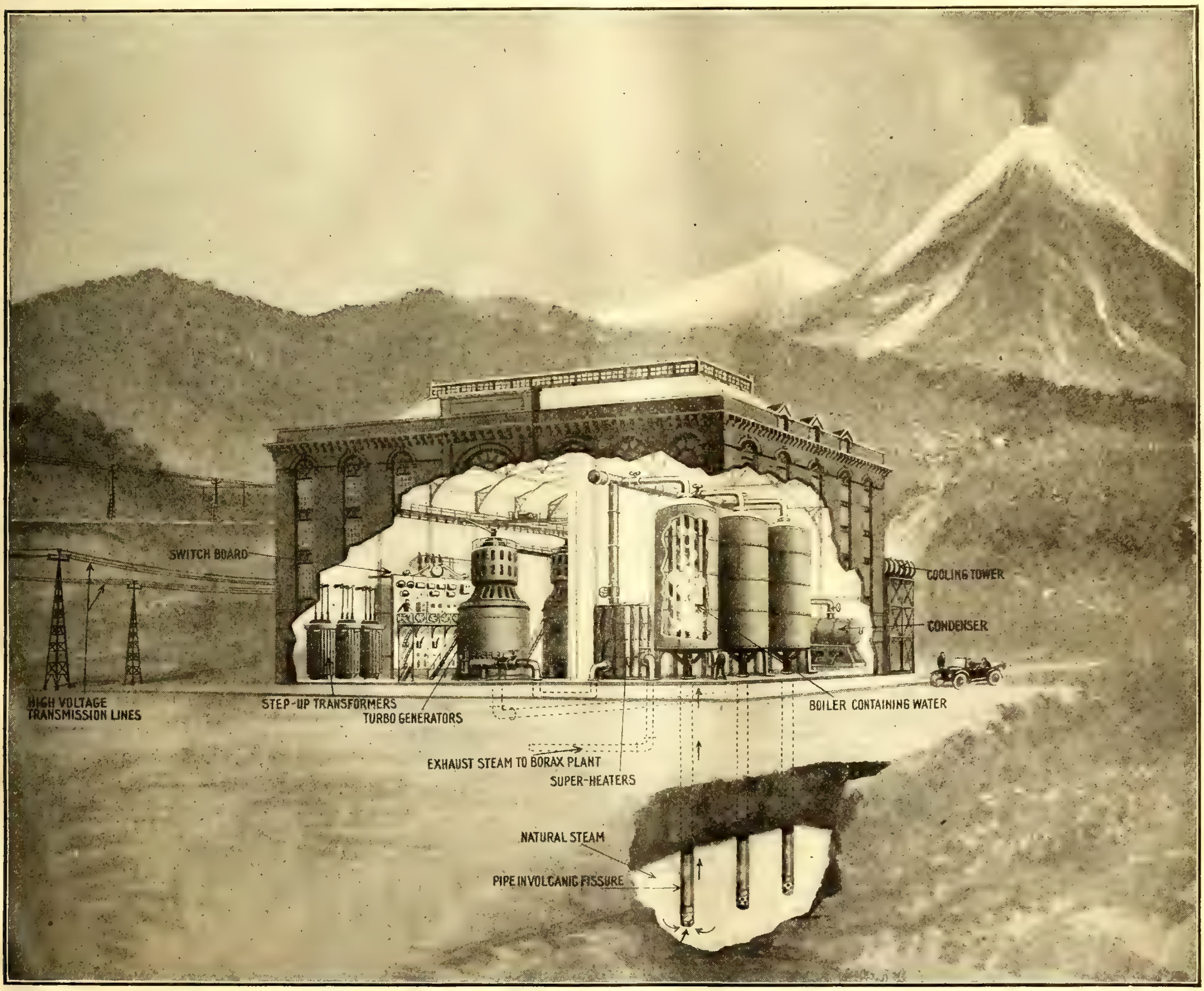
H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. IV. Whole No. 47 MARCH, 1917 Number 11

Volcano-electric Plant Develops 15,000 Horsepower

THE ocean waves give promise of some day furnishing vast quantities of electric power, not to mention natural gas power plants, wind motors, and a host of other more or less available and controllable rank folly to seriously consider such an undertaking, yet we have ever to face the facts and Fact, remember, is often stranger than Fiction.

The actual harnessing of an Italian volcano to an electric generating station of Prince Ginori-Conti on to his goal. As is well known, in Central Tuscany, near Volterra, there are numerous cracks in the ground, from which powerful jets of very hot steam spout high in the air with great violence and constancy, bringing up boric



A Volcano-electric Plant Developing 15,000 Horsepower Is a Reality in Italy. This Plant, Now in Operation, Utilizes the Heat in the Natural Steam Present in the Ground Near the Volcano to Heat Water in Boilers. Steam from These Boilers Drives the Turbo-generators, the Electric Current Being Transmitted Many Miles Away.

sources of natural energy, but who would ever dream of harnessing a VOLCANO (or rather volcanic heat) to an electric generating plant developing thousands of horsepower? Verily, it would seem like far-reaching usefulness is described by Professor Luiggi in *Engineering* of London. The ever-increasing cost of coal in Italy was one of the principal incentives that ever goaded the brilliant and original acid—which is very valuable—and other mineral substances of less importance. These powerful jets of superheated steam are called Soffioni—the *blowers*—and have been utilized for many years in the pro-

duction of boric acid and borax, and occasionally for warming the houses in the nearby village of Larderello. The larger proportion of the steam, however, is lost, having no local application, and with it is lost its very valuable heat.

Prince Ginori-Conti, the president of the Società Boracifera di Larderello, was the first, in 1903, to try to utilize this superheated steam for the production of motive power.

Elaborate experiments which were made very accurately demonstrate that each bore can provide steam at a temperature of at least 150 deg. C., and at the rate of from 15,000 to 25,000 kg. per hour, that is, practically, from about 1000 to 2000 theoretical horse-power per hour. Thus near Larderello there is the possibility of developing motive power up to thousands and thousands of horse-power. Encouraged by these results, Prince Ginori-Conti, in 1906, applied the steam to an ordinary steam engine of about forty horse-power.

The experience of several years has shown that this arrangement works well so far as the mechanical power of the steam is concerned, but that the borax salts and the gases mixed with the steam—especially sulfureted hydrogen and traces of sulfuric acid—have a corrosive action on the iron parts of the engine and are the cause of frequent repairs. This difficulty was finally avoided by applying the superheater and afterwards used for driving but to a boiler; that is, by applying it instead of fuel to an ordinary multitubular boiler in which steam was produced at a pressure of two atmospheres, then past thru a superheater, and afterwards used for driving a 300 horse-power condensing steam turbine, directly connected with a three-phase electric generator, which supplies the works and the villages around Larderello. This installation had been at work quite successfully for several months when the present European war started. Then, coal becoming very scarce, and prices rising up to prohibitive limits, the possibility of using on a large scale this natural steam became very important.

Prince Ginori-Conti considered it his duty to carry out this trial on a large scale, availing himself of his long and successful experiments. Acting on the advice of the Tosi Works of Legnano—specialists in steam turbines and alternating current electric generators—he ordered three groups of condensing turbo-electric engines, each of 3,000 kw. (4,000 H.P.), working with superheated steam at 1½ atmospheres, generated in specially constructed multitubular boilers, the latter arranged vertically and with aluminum tubes, both for better utilization of the heat and better resistance to the corrosive action of the natural steam from the Soffioni. This steam, it should be noted, is used instead of combustible; it loses part of its heat in the boiler, reducing its temperature from 180 degrees C., to about 120 degrees C., and is then utilized for the borax industries.

The steam thus generated in the boilers and used for the turbines is *ordinary water steam,* which, on its way to the turbine, passes along aluminum pipes heated outside by a current of superheated natural steam at 180 degrees C., and thus gets in its turn superheated to about 150 degrees C. After passing thru the turbine this steam is discharged into a surface condenser, the circulating water of which is in its turn cooled in an ordinary cooling tower, as shown in our accompanying illustration. The condensed steam from the turbines is, of course, pumped back into the boilers, and thus no natural steam ever comes in contact with the turbine; by this arrangement corrosion is completely avoided. This was the real and chief difficulty to be overcome.

The three-phase electric current is generated at 4500 volts and 50 cycles per second, stept up thru an oil transformer to 36,000 volts, and sent along aerial conductors to Florence, Leghorn, Volterra, Grosseto and many smaller towns of Tuscany, to be principally used as motive power for munition works during daytime and partly for lighting purposes at night.

One of the 3000-kw. units has been at work since January, 1916, the second since April, and the third has just been started. So far, the first two groups have worked quite successfully and have been a great boon to the industries of Tuscany, greatly crippled by the scarcity and high price of coal. This very successful harnessing of volcanic heat to an electric power-house can be increased practically to hundreds of thousands of horsepower, as the region of *Soffioni* extends for many square miles around Larderello.

Thus we see how apparently uncontrollable forces of nature have been tamed and harnessed to do the work of man. In America we are still in command of large coal deposits, but hydro-electric developments are fast becoming a highly profitable and paying investment. But when these have reached their limit, we may have to look to the ocean waves, and yet again future generations may witness the sight of electric power plants deriving their energy from the heat of the earth thru long steel pipes sunk down thousands of feet. In the light of modern science it seems possible.

MONSTER SEARCHLIGHT TO GUARD U.S. SHORES AGAINST AERIAL ATTACK.

A gigantic searchlight of 500,000,000 candlepower has been installed by the Government on the aviation field at Hempstead, L.I., N.Y., and it will shortly be put to tests to determine its worth as a *watchman* of our shores. Aviators will go up in biplanes, followed by "enemies." The searchlight will then find the "enemies" and the other machines, hidden by darkness, will attack and destroy them. The light has a radius of four miles, sufficient, it is believed, to pick up a machine and keep it within its arc, while anti-aircraft guns and aeroplanes pick it out and destroy it. The accompanying photo shows the new searchlight as erected at Hempstead.

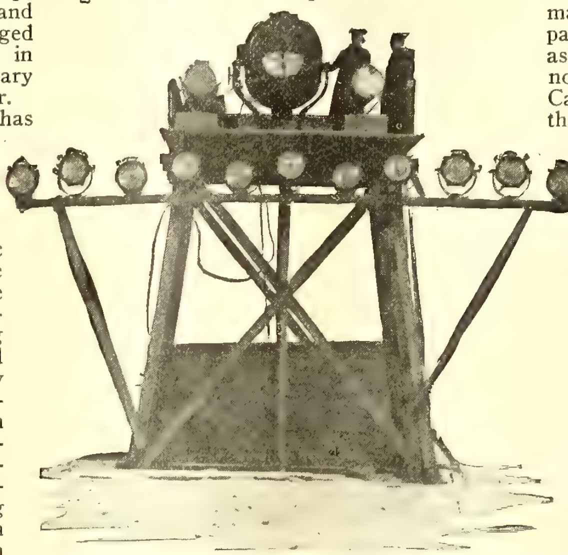


Photo Copyright by Central News Photo Service

Gigantic 500,000,000 Candlepower Electric Searchlight Recently Erected at Hempstead, L. I., by the U. S. Government to Guard Against Hostile Aerial Attacks. It Has a Radius of Four Miles.

COUNCIL OF NATIONAL DEFENSE.

In an act making appropriations for the support of the Army for the fiscal year 1917, Congress established a *Council of National Defense* for the coordination of industry and resources for the national security and welfare, and designates the Secretary of the Navy as a member thereof. It is contemplated that this council will eventually take over the work of industrial preparedness now being done by the Naval Consulting Board, and arrange it in such form as to be available to all departments of the Government in time of emergency. The excellent work already done by the Naval Consulting Board has been recognized by the President in the appointment of Mr. Howard A. Coffin, chairman of the committee on industrial preparedness of the Naval Consulting Board, as a member of the advisory commission nominated by the council composed of Cabinet officers. The act provides that the advisory commission be composed of seven persons, each of whom shall have special knowledge of some industry, public utility, or the development of some natural resource or be otherwise specially qualified for the performance of duties thereinafter provided, and also provides that the special knowledge of such commission may be developed by suitable investigation, research and inquiry, and made available for the use of the council. It is also stated that the work of the *Council of National Defense* will consist in the coordination of military, industrial, and commercial purposes; in the reclamation of highways, railroads, utilization of waterways, and employment of military and naval resources for defense; and the increase of domestic production of articles and material essential to the support of the population, both military and civilian, in time of war. The superiority of the foreign military machines is directly traceable to such co-operation.

WIRELESS 'PHONE FOR HOTEL PLAN.

Guests at the Hotel Oakland, of Oakland, Cal., may be able to talk by wireless telephone with friends on incoming steamers, if present plans under consideration by the hotel management are carried out.

Following the precedent by many hotels on the Atlantic coast, of installing wireless telegraphic sets for the benefit of guests, the management some time ago took up the feasibility of having a similar service installed in the Hotel Oakland, to be operated in conjunction with the ocean liners.

Recent negotiations by the federal government with certain interests who have been developing the wireless telephone for direct communication over the air route, together with experiments which Uncle Sam has been conducting with radio-telephonic systems, has led to the decision on the part of the manager, Mr. Carl Sword, to consider the practicability of having a wireless telephone establisht in the hotel.

The plan includes a co-operation among hotel managers all along the Pacific Coast for the purpose. A regular service for the transmission of important inter-hotel business, advance reservations by guests over the air, and a thousand other uses could be found for the convenience. The plan was suggested at the national meeting of the Hotel Men's Association held last year, but no active steps were taken.

Under the plan, as outlined at the present time, the various hotel managers of the coast would form a wireless association which would install apparatus.

20,000 Leagues Under the Sea

ONE of the most spectacular motion picture features produced lately is the dramatization of Jules Verne's "Twenty Thousand Leagues Under the Sea."

For many years attempts have been made to reproduce this masterpiece on the stage as well as by motion picture reproduction. However, science had not developed far enough, until quite recently, and hence all previous attempts failed. Only a short time ago, due to the several inventions of the well-known Williamson Brothers, has it been possible to actually take moving pictures under the sea, and the present picture is a direct result of the Williamson Brothers' untiring work along these lines.

It is well known that forty-seven years ago, when Jules Verne wrote his book in which he prophesied the submarine down to the most minute details, he met with quite a good deal of ridicule, due to the fact that the world at that time had not advanced far enough to appreciate his efforts. It is the old story of a man ahead of his time showing the world something which as yet exists only in his own imagination.

The new film which is now being shown all over the country and which has cost over a quarter of a million dollars to produce, is undoubtedly one of the greatest spectacles ever put before the public.

While of course it has not been possible to show the entire action as laid down by Jules Verne, it is surprising how close the picture people came to reproducing Jules Verne's idea in its entirety. While it was necessary here and there to embellish the story with new ideas, this has been accomplisht in a clever manner all the way thru. There have been some additions which might have remained out of the picture, as, for instance, the firing of the torpedo which Jules Verne had not provided for in his *Nautilus.*

The story opens with Uncle Sam, about the time of the American Civil War, sending out a frigate to destroy a certain "sea monster" which had been reported from time to time in the various oceans, and which monster had supposedly done great damage to shipping. No one had been able to kill the supposed monster and for that reason the American frigate manned by a capable crew as well as by several adventurous people including the French Professor M. Arronax, was sent out to effectively deal with the new terror. When the frigate finally meets the supposed sea monster all efforts to kill it are of no avail, but to the contrary the monster rams the ship, pitching M. Arronax and his companions into the sea. When they come to their senses, they find themselves on the back of the monster, which they discover is made of steel, this being the famous Jules Verne's submarine, commanded by the mysterious Capt. Nemo, who supposedly has a grudge against humanity and has sworn not to return to land but roam the seas until his end. M. Arronax and his companions are made prisoners by Capt. Nemo and upon their promise never to leave the undersea boat, they are accorded the freedom of the ship. The name of the strange craft is the *Nautilus* and this original boat has been carefully reproduced by the moving picture people at great expense and regard for details.

Above:—Captain Nemo and His Doughty Crew Aboard the Submarine "Nautilus," Made Famous by Jules Verne in His "20,000 Leagues Under the Sea," and Now Reproduced in the Latest "Movie" Bearing that Name.

Left:—Here We See Several Members of the Crew of the "Nautilus" Emerging Thru a Sea Drop Door to Walk on the Sea-bottom. Note the Comprest Air Guns.

Below:—Sailors From the "Nautilus" Have Here Caught a Gigantic Turtle. The Men Carry Independent Comprest Air Tanks on Their Backs.

Capt. Nemo, the main character of the story, is shown in one of our photographs with his crew on the deck of the *Nautilus.* The latter, constructed by the Williamson Brothers, is in itself a thoroly seafaring machine, equipt with all the various kinds of air tanks for submerging and raising it, and is propelled by powerful motors equipt with storage batteries. As mentioned be-

(*Continued on page 831*)

Shooting Big Game on the Electric "Movie" Target

THE motion picture camera has penetrated the distant jungles so often that it is the daily experience of the movie "fan" to fearlessly stalk big game across the screen; to see the Rocky Mountain goat cavort on the spot where Charlie Chaplin so lately fell, is now a common occurrence. The grizzly bear and the Bengal tiger are equally familiar to us.

It was therefore inevitable that some one should supply the missing link, so that the big game hunter, or even the amateur marksman, could continue his sport, using the pictured game for his target.

It is a very simple matter to take a steel screen and, painting it white, throw a picture upon it and then with a rifle shoot at the animal moving in the picture. But there is little satisfaction in this until some means is secured to enable the moving picture hunter to know whether his shots have gone true or not.

This effect was accomplisht by the wonderful invention of Elliot Keen, an inventor of New York City. The basis of this device is a number of cast-iron balls hanging from a short piece of chain back of a steel screen, as seen in the upper right photo.

On the face of this steel screen the picture is thrown from a regulation moving picture projection machine. Each ball is so arranged that when the bullet strikes on the opposite side of the screen the ball makes an electrical contact and so identifies itself on an annunciator.

There are about one thousand of these balls behind the screen. The balls are so placed that the location of the point of impact of the bullet is establisht within three and one-half inches, electrically.

There are 33 wires stretched horizontally across the screen, evenly spaced, and 33 wires arranged vertically. At the many points where these wires cross are the contact-making balls. It will, therefore, be seen that a bullet striking against the target will connect certain two wires and as the latitude and longitude lines upon the map enable us to establish exactly any given location, so the connecting of one vertical and one horizontal wire establishes accurately the point where the bullet struck upon the steel screen.

It is evident that if only those wires which cross beneath the picture of the animal be connected with the battery then stray bullets will be ineffective.

If for a moment we consider the bird in the picture as not moving and shown ex-

Upper Left:—Front View of Marvelous Electric, "Movie" Shooting Gallery, Where One Can Practise Hitting Moving Game.

Upper Right:—Back of the Picture Screen: If Your Bullet Makes a "Hit," It Moves One of the 1000 Balls Shown, Closing an Electric Contact.

Lower Left:—Appearance of Special Motion Picture Projecting Machine, Fitted with Numerous Electrical Contact Fingers.

Lower Right:—Close View of Rifles, Each Equipt With Electrical Contact. Note Lamp "Score" Board on Beam.

actly in the center of the screen, it will be easily seen that the sixteenth wire horizontally, and the sixteenth wire vertically, must be connected with the battery in series with the bell or signal. The bullet, directed by the marksman and which hits the bird, will actuate the suspended ball and close the circuit between these two wires, thus completing the circuit momentarily so that the signal indicating a *hit* will be given. This is accomplisht by means of a lamp, placed in front of the gallery as seen in the lower right view.

When the bird starts to move the illusion will be produced by the movement of the film, or the situation which existed in the still picture will be changed every sixteenth of a second. Therefore, some means must be provided to connect the proper two wires with the battery for each location establisht by each picture passing thru the machine.

To accomplish this the film is perforated before being used in the gallery, while on the projecting machine there are arranged a number of fingers, operated by a cam to drop upon the film during the period when the picture is shown on the screen. These fingers are raised to permit the film to move. When the film comes to rest and the steel fingers drop upon it, two of the fingers pass thru the previously made perforations and thus connect the two essential wires to the battery. This part of the projecting machine can be seen in the lower left photo.

During the period when the picture is moving the bullet might, and likely does, strike the screen. It was, therefore, necessary to establish a secondary means of keeping the two proper wires alive, even tho the screen was in the dark. To do this a number of relays were introduced, actuated by a commutator connected with the projecting machine.

It will be seen, therefore, that with the device thus far described, a man shooting at this moving picture with a rifle would succeed in ringing the bell every time he hit the pictured image. Inasmuch as public shooting galleries oftentimes have several persons shooting at the same time confusion might result as to who made the hit when the *hit signal* sounded. Therefore a special device has been designed which keeps the scores of the individual marksman.

The basis of this device is a small contact placed on the rifle itself which is made when the trigger is pulled. This moves a brush electrically by means of an escapement over the terminals of a number of lamps. The other terminal or ground wire from the lamps is connected with the signal circuit, so that if the signal of a hit came at the exact period when the brush of the escapement released by the trigger was sweeping over the terminal of the lamp, the lamp would be lighted; if no signal came from the screen immediately after the trigger was pulled, then the brush would harmlessly sweep over the lamp terminal and the lamp would remain dark. A cord connects each rifle with the mechanism, and it has been found that six rifles can be fired simultaneously at a moving picture, with practically no error in the score, altho it will be evident that there is a short time element and if two rifles fire together and only one makes a hit, then both will receive credit. The upper left illustration shows the general arrangement of the electric shooting gallery as used in one of the amusement places in New York City.

The electric moving picture target simply consists of one circuit which is broken in three places—one at the gun, one at the projection machine and one at the steel screen. If, when the trigger of the gun closes, one of these breaks and the bullet at the screen closes another of these breaks, the projecting machine closes the third by connecting the battery to the essential wires, then a *hit* has been made.

In spite of the fact that this is a somewhat complicated machine, having cost $27,000 for its initial trial installation, it has been found to stand up very satisfactorily under practical use. The most bothersome feature has been found to be the inaccuracy of the film itself, which changes its dimensions when exposed to the strong arc light needed to project the picture.

To overcome this a very delicate framing device was installed which framed the fingers up and down to compensate for the contraction and expansion of the film and for the wear on the sprocket holes, etc.

To prove the accuracy of the device, the inventor has adopted a peculiar bullet, carrying in the point a small amount of flash light material. The action of this bullet is to show a flash of light, which identifies the exact point of contact, thus showing the gunner the exact position at which he has aimed.

To have these 33 horizontal wire terminals and the 33 vertical wire terminals each represented by a finger, or 66 steel fingers to be raised and lowered each sixteenth of a second upon the film, was found to be impractical, because of the fact a single picture on a moving picture film is but three-quarters of an inch wide and altho the horizontal fingers occupy one side of the film and the vertical fingers occupy the other side of the film, to place 66 such fin-

(*Continued on page 851*)

"WIRELESS" MOVIES VERY POPULAR.

The "Honor System" photo play produced by the William Fox Corporation and just recently released, foreshadowed last summer, in its first presentation, remarkable achievements in the scientific field, which have since come to pass.

Wireless communication between the United States and Japan, which has already been effected, was foreshadowed in this presentation, and scenes were taken showing the imaginary wireless feat in progress.

The story runs thus—Joseph Stanton, a wireless inventor, who has been a student of electricity for many years, is the hero. It is his dream to effect wireless communication between the United States and Japan, and, indeed, this did prove, later, one of his crowning achievements. The part is played admirably by Milton Sills, who is himself a scientist of considerable attainment, and a graduate of the University of Chicago.

We are introduced to wireless apparatus, of the hero's own make, which, tho capable of transmitting but a short distance, is equipt to receive messages within a radius of many thousands of miles.

A Thoughtful Moment From the Film-Drama "Honor System"—in Which the Scientist-Hero Becomes Blind Thru His Radio Researches.

We quote Mr. Sill's amusing remarks:

"As a kid," says Mr. Sills, "I had two inseparable companions. The father of one was a lineman for a telephone company and the father of the other was superintendent of a big power house.

"The whir of the electrically propelled machinery just seemed to get into my system.

"I guess it was a sort of 'call of the spark.'

"When I was eleven—that was in 1893—the World's Fair was held in Chicago. Dr. Charles P. Steinmetz, the electrical wizard, delivered an address in one of the buildings, and concluded with an offer to answer any questions put to him by the audience.

"I asked the first and was so bent on getting more information on my pet hobby that I just refused to let up and put one query after another to him. Those in the audience must have felt that I was a nuisance at first, but I suppose they gradually came to understand that it was just my enthusiasm.

"Steinmetz finally laughed and said from the platform that he would be glad to spend an evening with me. Then he walked right down the aisle to where I sat and shook hands with me."

The film play proceeds further into various interesting episodes, but ends quite touchingly. Near the close of the inventor's career, he meets with an accident which blinds him forever. And we get a last glimpse of him with his sweetheart reading to him.

Traveling at 500 Miles Per Hour in the Future Electric Railway

AN electric railway over which cars will fly at the astonishing speed of 500 miles per hour, or at the rate of 8.3 miles per minute, is one of the scientific possibilities of the day and one which is engrossing some of the master engineering minds of two continents.

An electric railway having such possibilities was broached by Professor Boris Petrovik Weinberg, Instructor in Mechanical Engineering at the Imperial University of Petrograd, Russia, at the recent New York meeting of the American Association for the Advancement of Science. Professor Weinberg has even built a model of his proposed 500 mile per hour electric railway; but the first difficulty met with in considering his really remarkable invention is that the cars are supposed to be shot thru a tube in which there is created a partial vacuum.

It would seem quite prohibitive, at least with our present understanding of such engineering matters, to build even a relatively small railway of this type and capable of maintaining such a speed as 500 miles per hour where the cars would have to pass thru an evacuated tube or tunnel, even if this were divided into short sections or locks, so as to reduce the total quantity of air that would have to be pumped out of the tunnel at a given instant. If we had available to-day a system extending from New York to San Francisco and on which the cars traveled at the rate of 500 miles per hour, then the trip between the great Metropolis of the East and the Golden Gate could be made in five hours. In other words one could breakfast in New York and lunch in 'Frisco!

Many other remarkable possibilities of such a railway system will immediately suggest themselves to the reader.

The editors of this journal have evolved a system for ultra high speed railway locomotion, such as 500 miles per hour, and which has been portrayed vividly by the well-known artist, Mr. George Wall, on our front cover. This system does not involve any such hyper-scientific proposition as that requiring an evacuated tube thru which the cars are to pass, but, instead, brings into play the rather slightly known method of eliminating friction by *electro-magnetic levitation*, on the principle developed to some extent a few years ago by one Emile Bachelet, formerly of Mt. Vernon, N.Y., but now engaged in research work in England.

The underlying principle of electro-magnetic *levitation*, as followed out by the Bachelet floating railway system, is readily understood by referring to Fig. 1 herewith. Here we have an electro-magnet coil M and an aluminum ring R. Now, if we pass an alternating (rapidly changing from positive to negative and vice versa) current thru the magnet coil, it will produce, in turn, an alternating or constantly changing magnetic field. Such a field will repel sheets or rings of copper or aluminum, owing to the Eddy currents which are set up in them, the phase of these eddy currents being retarded by their self-induction. Hence, if we have an electro-magnet M, excited by an alternating current as in Fig. 1, and if we hold lightly an aluminum ring R, just above the pole of the magnet, we find that the alternating magnetic field will react in the manner just described, and forcibly *repulse* the ring upward, causing it to assume the position indicated by the dotted ring.

Again, if the aluminum ring is held by four cords and the alternating current past thru the magnet coil, the ring will remain floating in space above the magnet as shown.

In the Bachelet system of levitated locomotion, there is involved a fundamental disadvantage, which rapidly assumes alarming proportions when one comes to consider building a commercial railway of this type. This disadvantage lies in the fact that the cars, made of aluminum or having suitable aluminum inductor plates mounted underneath them, are intended to be *levitated or raised into space*, so as to eliminate mechanical friction between the cars and the track, by a contiguous series of powerful and expensive electro-magnets spaced evenly along the track and just below it.

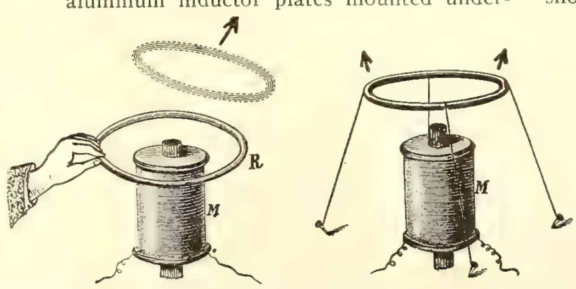


Fig. 1.—Demonstration of the Levitation Phenomenon Occurring When an Aluminum Ring Is Placed Over an Alternating Current Magnet M; the Ring R being Repelled Upward.

It does not require a great deal of calculating to arrive at the conclusion that it would cost a small fortune to build such a railway even if it were only a few miles in length, if it had to be equipt with such a series of closely spaced, powerful electro-magnet coils.

As is well known, it is possible to arrange an electro-magnet of proper proportions between two horizontal aluminum plates, and when excited by an alternating current, it will be found that the reaction of the magnetic flux set up will *lift the magnet coil above the lower aluminum plate*, and also *cause the upper aluminum plate to be levitated, or raised above the coil.*

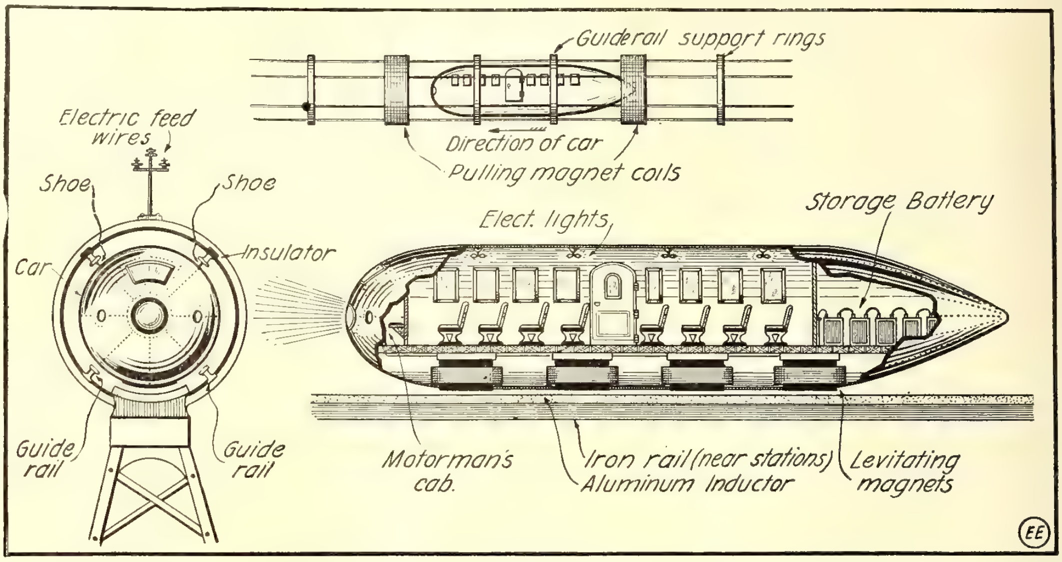


Fig. 2.—The 500 Mile Per Hour Electric Railway of the Future, Will Quite Likely Be of the Levitated Type, as Here Illustrated. Powerful Electro-Magnets Within the Car Raise It Above the Track, while Properly Spaced Solenoids Pull the Car Along.

Here is the germ of a revolutionizing idea, viz., why not transpose the conditions in the Bachelet levitated railway system, and instead of lining the track with millions of dollars' worth of electro-magnets, simply place the levitated magnets within the car and construct the lower rail of properly spaced aluminum inductor sections? By this means it becomes more feasible to construct such a levitated railway and at various points along the railway suitable ring-shaped solenoids or hollow tubular electro-magnets are placed to propel or pull the car forward.

The accompanying diagram, Fig. 2, shows several details of the levitated electric railway which the editors believe would work out successfully, if the engineering details are properly taken care of. The car itself is patterned after the modern Zeppelin flying machine, having the front end in the form of a hyperbola and the rear end tapered off, so as to offer the least possible resistance to the air as the car shoots forward at the rate of 500 miles per hour. A series of powerful *levitating* electro-magnets are mounted under the floor and within the shell of the car as shown. A high tension alternating current is supplied over feed wires carried on cross arms at the top of the tubular track system, and this current could be taken into the car thru special contact shoes or wheels on either side of the car body; this alternating current being used to excite the levitating magnets for lifting the car from the track.

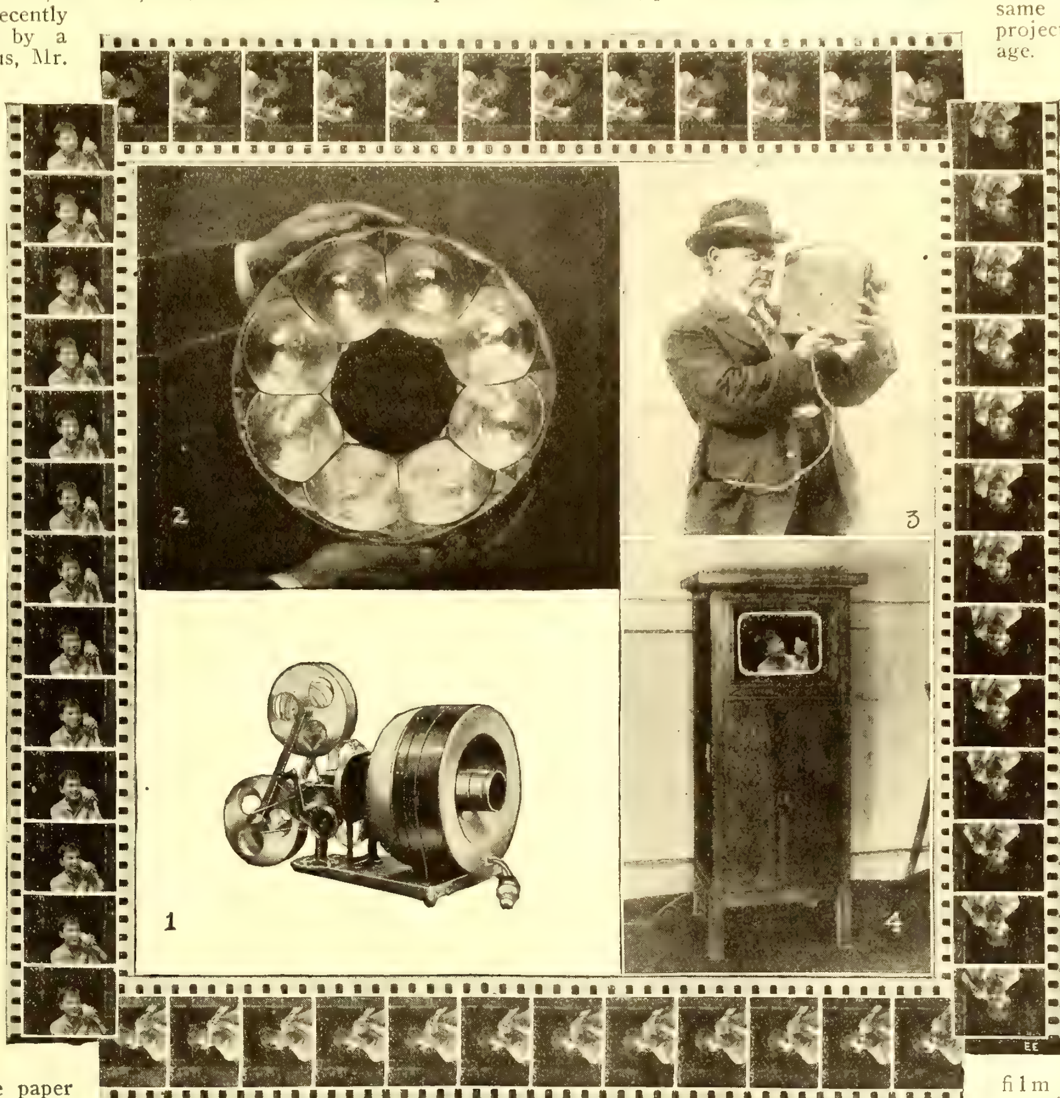
The road-bed is built up of a specially designed aluminum inductor rail, with a lower sub-rail of iron at station approaches. A small storage battery could be carried at the rear of the car so that in slowing down or stopping, and instead of exciting the levitating magnets with *alternating current* they could be charged with *direct current* from the storage battery, and thus a greater frictional effect produced between the moving car and the rail. The flux from the electro-magnets within the car would, in this case, react on the iron sub-rail.

The car would be propelled forward in a manner similar to that of Bachelet's, or by

(Continued on page 851)

An Electric "Movie" Machine for the Home

ONE of the greatest objections to the standard type of motion picture machine for the individual user is that it employs a celluloid film with considerable expense attached thereto, as well as the fire danger of this inflammable article, thus barring it from use in homes, schools, etc. However, this has recently been overcome by a New York genius, Mr. Hartwell Webb, who has spent a number of years in developing an entirely new motion picture apparatus. The limitations above cited are at once overcome by this new invention, which is based upon the fact that paper is cheaper and far safer than celluloid film; aside from this it will produce a motion picture of equal quality. It can be handled by a child as well as by a professional operator. For inflammable film exposed to the arc light, it substitutes paper films, exposed to the mild rays of the incandescent bulb light. For the expensive celluloid film it substitutes an inexpensive paper strip, involving no fire risk and which may be left about the house or shipt thru the mail.



Illustrations Above Show: 1—the Projector; 2—the Lamp Ring; 3—the Camera; 4—"Home" Type of Projection Machine and 5—a Typical Strip of Paper Film (the Border).

The adoption of a paper tape or strip for projecting work necessitates the use of a somewhat different projecting machine, as the light cannot penetrate the paper film sufficiently to show the image clearly on the screen. Therefore, it was necessary to invent a new illuminating scheme for this kind of work, and it was not long before Mr. Webb evolved one which has proven very successful. One of the latest type of projecting machines is illustrated at Fig. 1. Its general construction is very similar to the present type moving picture machines, the only difference being that the film is illuminated as stated above.

By referring to the first photograph, it will be noted that the paper film is held on the top reel and is taken up on the lower one, when in operation. Similar gears are used for feeding this photo strip, as in an ordinary machine. The source of light is obtained from a number of incandescent electric bulbs, placed in reflectors and arranged in circular or ring form. This unit is placed in the circular chamber as seen at the right. The face of the bulbs is directed towards the paper film so that the light falling upon it is reflected towards the projecting lens, which is stationed on the front of the chamber. A photograph showing the exact construction of the luminous unit is reproduced at Fig. 2. The central opening is used to permit the reflected picture to pass thru and enter the projecting lens. The general operating principle of this machine

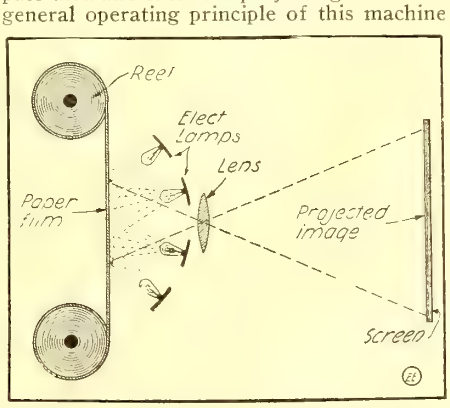


Diagram Showing How the Light is Reflected on the Paper Film, and the View Projected Thru the Lens Onto Screen.

is exactly the same as that of a postcard projector, with which we are all familiar, the light is focused upon the postcard and reflected thru the lens. It will be noted that the general make-up of the projecting machine is just the reverse of the commercial ones used to-day. The light is focused on the picture in the opposite direction to the projected image, while the light of the present standard machine is focused in the same direction as the projected screen image. Fig. 4 shows a different type projector intended primarily for the home. The picture is focused on a transparent screen, the photo reel being operated by a motor.

The negative, which is the original photograph taken of the moving object, is first made on a regulation celluloid film and taken with a standard moving picture camera. The construction of the new instrument is very simple as seen from the accompanying photograph. Standard motion picture negative films are used, and the camera carries 100 feet of film, being so constructed that it may be loaded in broad - daylight. The film may be operated at will either by the usual hand-crank or by merely pressing a button, which closes the circuit to a tiny, concealed electric motor, driven from dry batteries carried in the pocket of the operator. The connections are obtained by means of a flexible conductor, fitted with plug connectors at both ends. In this way it can be operated without a tripod, a great advantage in emergency use.

After the pictures have been photographed upon the film, the latter is developed in the usual manner and the print is made upon a sensitized paper strip, which is used in projecting the picture on the screen. A sample of such a paper strip is shown as a border about the photos herewith. The general make-up is about the same as for regular movie films with the difference cited above.

It is at once apparent how universal are the uses of this wonderfully developed camera intended for Mr. Everyman and his family. The amateur may take his own pictures, print and develop them in his dark room and project them on his parlor wall.

(Continued on page 831)

HOMEMADE ELECTRIC VAPOR BATH.

Vapor baths and also plain sweat baths are often highly beneficial. If one provides a suitable rubber cloth (or blanket) cover to cover the body, as shown in the accompanying illustration, advantage may be taken of this treatment at small expense. First we may use the ordinary electric sad iron, suspending the iron on a hook beneath the chair. This will give the patient a good sweat. A toaster or other small electric stove will serve this purpose very nicely. By placing some medicating, vaporizing fluid in a small vessel and then heating this solution by immersing an electric water heater in it, a vapor bath will be had. It will be found extremely efficacious to employ one of the well-known *Vaporel* devices for this purpose, which require but little current, while they rapidly vaporize, by electrolytic action, any kind of medicant or disinfectant.

Contributed by ALEX. K. CAMPBELL.

To Take a Vapor Bath at Home, All You Require Is an Electric Flatiron, a Vessel to Hold the Medicating Liquid and a Rubber or Other Blanket Arranged in the Manner Shown.

THE PERISCOPE THAT IS INVISIBLE.

THE submarine periscope is one of those small, yet all-important topics upon which naval officers have been wont to argue for some time; or, in fact, ever since the submarine has become an up-to-the-minute factor in naval warfare. One thing we know, and that is that the submarine is *running blind* when it begins to submerge so deep that its periscope disappears beneath the surface of the water.

It is often mentioned by naval people and others that, granting the point we have an *invisible* periscope; then with an observant officer on a torpedo boat, he will invariably catch sight of or *spot the white trail* made by the periscope in its course thru the water. Needless to say this has been the worry of more than one submarine officer.

But the periscope is not always moving, nor need it do so. It often happens (as recorded a number of times in the present war) that a submarine has been lying on the bottom of a bay or harbor for a number of hours, and arising, it becomes desirable to sight the bearings thru the periscope; in other words, there are many opportunities for using the periscope where, if it were *practically invisible*, it would render a submarine safe from attack by torpedo boats or scout cruisers, some of which can pounce down upon the sub-sea boat at a fifty-mile-an-hour speed.

About every imaginable manner of painting periscopes and submarine hulls has been tried out by the various Navies of the world. It was long considered that, if the structure of the submarine or ship could be painted with a certain splashy formation of sea blue and white, that it would very obligingly merge into the color scheme of the sea, and thus cause the periscope or other part of the boat to become invisible at even short distances.

This, however, has been proven to be incorrect by no less a genius than Mr. Wm. A. Mackay, a mural decorator of New York City. Mr. Mackay recently delivered a lecture to the officers of the U.S.S. *Tallahassee,* and he explained his technique of rendering the periscope invisible in simple language. Said Mr. Mackay: "The thing to do, evidently, to make the periscope invisible, would be to paint that object the color that most resembled the water. But it seems that such is not the case.

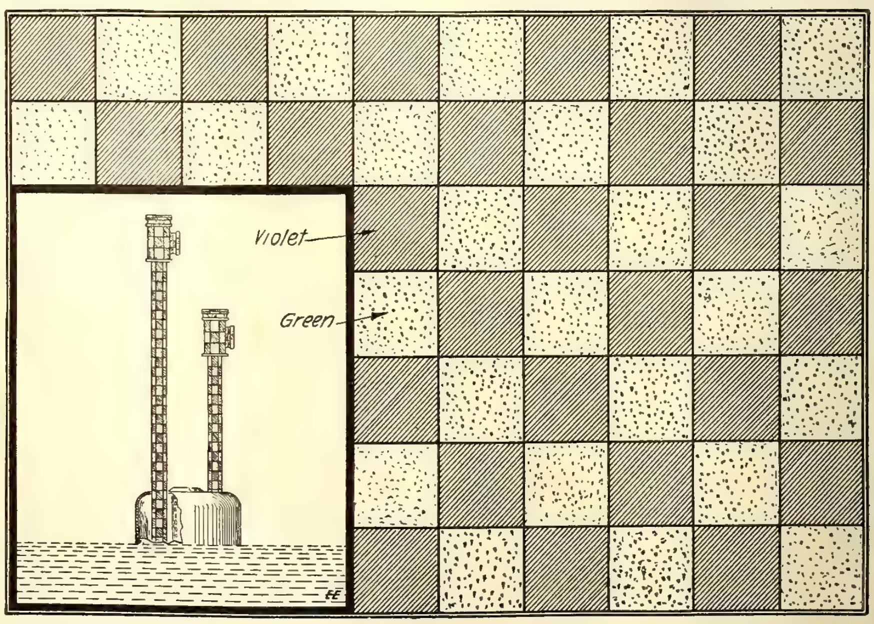
If one takes up some of the sea water in his hand and examines it closely, he will at once perceive that it is not blue at all, but quite colorless and translucent—exactly similar to the water you drink from a spring or well. It has been ascertained by scientific analysis that the blue of the sea is composed of nothing more or less than *light*, and light is a combination of several primary colors. Under the peculiar conditions obtaining at sea, two of these colors combine and the resultant vibrations in the ether cause our brain to see blue. But this is not the blue that the artist paints on his canvas of an ocean scene. That is a paint—the other is simply radiant light so arranged in its vibratory combinations as to produce certain definite impressions of *color* on the optical machinery of the human brain.

To cut the story short, Mr. Mackay made up a checker-board affair, the alternate squares of which are painted green and violet. The vibrations of these two colors, when viewed jointly by the eye, would then attack the retina, and mixing, cause the brain to receive an impression of sea blue.

This remarkable scheme is shown in the illustration herewith. If you have not forgotten how to dabble in water colors, try it out yourself. You may have to experiment a little to get the right shades of (glaring) green and violet, but you will obtain surprising results eventually.

In demonstrating this wonderful scientific principle, Mr. Mackay took a large board which he had previously prepared, moved it to some distance from his guests, and held it up for their inspection. "What color does this board seem to be?" he asked. All were certain that it represented a beautiful *sea blue*. This *blue* board was then taken out on a boat some distance away and suspended above the deck, with the ocean as a background. It actually became invisible! Even t a short distance, not even an outline of it could be observed. Thus, if it had been the periscope of a submarine, it would have insured the crew and officers against attack, as surely as if they had been concealed under 50 fathoms of water.

After the performance the board which had appeared sea-blue to all was shown to the audience at close range. It was *not* sea-blue now, but it was painted in checker-board fashion in a vivid green and purple, as schematically indicated in our illustration.



The Invisible Periscope Has Seemed to be an Elusive Myth, but an Artist-philosopher of New York Has Found That a Periscope Painted Checker-board Fashion, as Above, with Alternating Patches of Green and Violet, Will Become Invisible Even at Short Distances.

DANCED TO WIRELESS MUSIC SENT 31 MILES.

Dancing to music transmitted by wireless was a novelty offered recently to guests at a house party in the home, in Morristown, N.J., of Theodore Gaty. The music was played in the laboratory of the de Forest Radio Company at Highbridge, New York, and was received at the Gaty home on an instrument so delicate that it has picked up radio signals sent from the German government station at Nauen.

The fox trots and waltzes played thirty-one miles from the Gaty home were made sufficiently loud by a special amplifying device. The plan was suggested after music sent from the de Forest laboratories had been heard by accident. Music has also come over the Gaty aerial from New Rochelle.

The receiver caught the sounds so distinctly that it recorded remarks of the sender and the grinding of the spring as the phonograph was wound.

Mr. Gaty and his two sons, one of whom is a student at Cornell University, have made a hobby of wireless and have a very elaborate plant.

How Electro-Pneumatic Tubes Shoot Mail Underground

THE accompanying views show respectively a Monorail Car used in a newly devised 30-inch underground tubular railway; a view from the skeleton track of the tubular railway and the appearance of the pneumatic mail transportation tube terminals used in the Chicago General Post Office.

The rated power of the motor in the Monorail car is 4 horse-power. The car is designed for speeds between twenty and thirty miles per hour, but it is not limited to these speeds. With a motor of suitable capacity, the car can easily attain a speed of sixty miles per hour. As the system is designed, the cars can pass around curves of very short radius without danger of leaving the track. The thrust due to centrifugal force is taken directly by one or the other of the side rails.

The capacity of the Monorail car is well shown by the man lying in it. The construction of the car is also shown clearly. The car is 4 feet long and 25 inches in diameter inside. Externally it is 7 feet 3½ inches long, from buffer to buffer. The tunnel thru which it runs is 30 inches in diameter. Cars and tunnels can be made of any size adapted to the material to be transported.

The total length of the circular testing track at Cambridge, Mass., where the cars are tried out is 1,534 feet. The car travels around it at a speed of about twenty miles per hour, requiring about one minute to make the circuit, but this speed can be increased or diminished as desired by power controlling devices located in the station.

The current is led into the moving car thru T-shaped trolleys on the top, the current returning thru the bottom rail. The upper rail is, of course, insulated from the supporting rail. The side rails act as guides only.

This automatically controlled electric railway has been designed to provide a means of underground or surface transportation which will have a larger capacity than a pneumatic tube. The system is automatic in its control. After a car or train is started it maintains a constant speed regardless of grades or curves. Before the train is started a mechanism is set on the first car, which indicates at what station the train is to stop. On approaching the station this indicating device causes the train to switch off the main track to a siding on which the station is located. The train quickly and positively stops itself when in the station by a special mechanism.

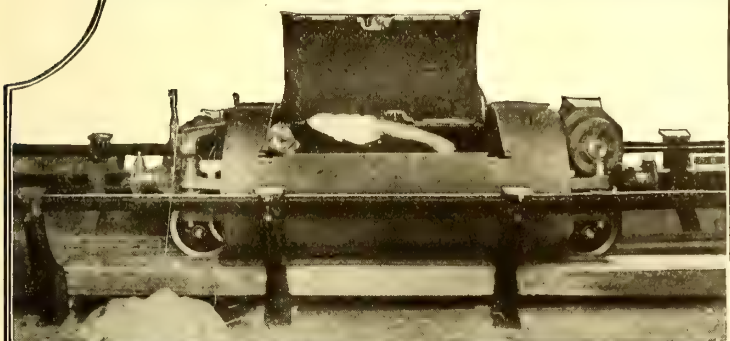
This system can be of any desired length. The size of the cars and the dimensions of the tunnels thru which they run may also be varied in order to provide for the different kinds of service. It is particularly suited for use under conditions where a pneumatic tube would be of insufficient capacity, and where a trolley system of the usual type with attendants on the cars would be too large.

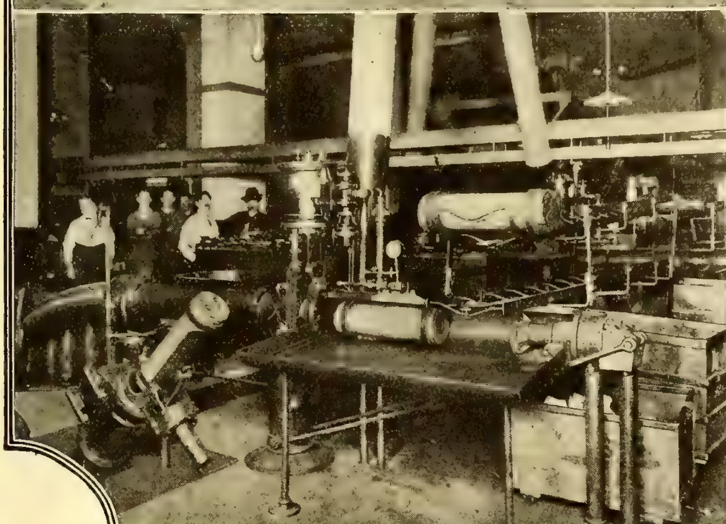
Many of the larger cities are equipt with pneumatic tubes, which connect the various post-office branches with one another. The mail, placed in special carriers, is shot thru the tubes by compress air. This is supplied by electrically driven and controlled air compressors.

In these underground mail tubes, the carriers have a speed of about thirty miles per hour and are usually dispatched at minimum intervals, varying from ten to fifteen seconds. If dispatched in two minute intervals and traveling forty-four feet a second, they will be approximately 528 feet apart in the tube, and there will be ten carriers in transit per mile of tube. The initial air pressure is a constantly varying quantity which depends upon the length of the tube, the number of cars in transit at any given time, and other conditions. Speaking generally, however, we find that for a tube line about two miles in length, the initial air pressure would be approximately six pounds per square inch, or three pounds per mile of tube. This ratio, however, does not hold for any length of tube line, but is approximately true for the lengths of line ordinarily used in the post-office service.

The specifications of the United States Post Office Department, under which this pneumatic tube service is installed, call for tubes eight inches inside diameter. The carrier or traveling container, when inserted in the tube, is propelled at a speed of thirty miles an hour as stated above, and each carrier will hold 500 letters. The tubes can transport 200,000 letters an hour in either direction.

The Government experts estimate that every day 20,000,000 letters are advanced by the pneumatic tube service. Twenty-eight hundred carriers are constantly in motion traveling from one post-office station to another thru the pneumatic tube systems. The authorized mileage of pneumatic tube service in 1898 was but 16.2 miles, while in 1916 this figure had climbed to 113.2 miles. One thing about this system of transporting mail rapidly is that, there is never any blockage due to winter storms, or street congestion. The push of a button, the hiss of escaping air, and your letter, in company with 499 others equally important, is shooting along under the streets and rivers with express train velocity.





Top Left—Monorail Car as Used in New 30-inch Underground Tubular Railway. It Takes Electric Current Thru Special Trolleys From an Insulated Conductor Running Along Just Above the Car. Rated at 4 Horse-power. Speed Attainable 20 to 60 Miles Per Hour.

Lower Left—A Glimpse of the Electro-pneumatic "Mail" Tube System Used in the Larger Cities. The "Mail" Is Packed in Carriers, 500 Letters in Each One, which Are Shot Thru the Tubes at Precise Time Intervals, with a Speed of 30 Miles Per Hour.

Below—The 30-inch Diameter Tubular Track System for the Monorail Electric Car Shown in Upper Left View. The Side Rails Act as Guides Only. Note the Insulated Trolley Wire at the Top. A Possible Forerunner of Future Electric Railway Systems.

Electricity and Life

By FREDERICK FINCH STRONG, M.D.
Lecturer on Electro-therapeutics, Tufts Medical School, Boston

SCIENTIFIC progress during the past three decades has perhaps surpast that of all preceding ages; but we are still in the kindergarten class when we compare what is known with that which is still to be discovered. To *discover* means practically the same as to *uncover,* implying that the truth or fact was there all the time but was hidden, covered, occluded, or *occult;* and is it not a fact that many of the electrical discoveries of to-day would have been regarded as *supernatural* or *occult* by the scientists of a few generations ago? Of course there is nothing supernatural in the strict sense of the term, but many things remain *occult,* altho science is daily uncovering new and hitherto undreamed-of marvels.

There exist great *Cosmic Forces* of which we still know but little. Gravitation is one of these; we know something of its laws and the results of its action, but nothing whatever of its real nature. Electricity is another; of this we know somewhat more, and we now recognize it in a variety of forms, as light, heat, chemical action, magnetism, etc., but its *true nature* is still a deep mystery. *Life-force* or *vital energy* is another great Cosmic Principle; thru its action electrons are formed into atoms, atoms into molecules, molecules into crystals and chemical compounds, and these into the bodies of plants, animals and of man. We have no name for this force, but thru its action the great Cosmic Scheme of Evolution goes on. In India they call it by a Sanscrit name—*Prana.* Here in the Occident we have not yet officially recognized this force; it is quite unorthodox to even suggest that it exists—simply because we have not been able to measure and record it by our still comparatively crude laboratory instruments.

Demonstrating in a Startling Manner, the Appearance of the Human (the Author's) Body When Charged With a High Frequency Current. This Picture Shows Exactly How a Person Charged From a Powerful High Frequency Apparatus Would Appear to Our Unaided Eyes, Were They Attuned to Respond to Vibrations of One or Two Millions Per Second, Instead of From 380 to 760 Million-Millions Per Second (the Range of Normal Human Vision). This Display Greatly Resembles the Natural Aura Surrounding the Human Body, but which Average Persons Can See Only by Gazing Thru Special Chemical Screens.

Electrical Autograph of the Human Hand, Showing the Radiations from it When Charged with a Powerful High Frequency Current.

A few years ago, when almost every scientist was a materialist, we believed in nothing but matter and force; to-day science recognizes the necessity of a third basic principle, *Intelligence* or *Mind;* without this we can satisfactorily account for none of the facts of the world in which we find ourselves. Its manifestations in matter thru the Cosmic Forces give us at least a working hypothesis of life.

As electricity has been the great field for the investigations of the past century so will the nature and manifestation of the *Life-force* be the source of the discoveries of the future. Even to-day we may hazard a few statements regarding this hypothetical *Prana* or *Vital-force.* For example, it comes to us—like all other active forces—from the Sun. It is stored and transmitted by plants and by the oxygen of the air, and in the human body it appears to be distributed thru the great Sympathetic Nervous System to every organ and tissue of the body. The Sympathetic nerves radiate from the Solar Plexus—our *Sun-center.* If bacteria or poisons interfere with this circulation, as for example in *infantile paralysis,* the muscles from which the supply of life force is cut off, lose their power of reaction and wither away. It is in this connection that we may study the action of certain electric currents as applied to the treatment of disease. It would seem that certain types of alternating currents of high frequency and voltage greatly facilitate the distribution of this vital principle (Nerve-force, Prana, or whatever you choose to call it), and this explains the action of one of the most valuable of recent medical discoveries.

In 1893, Dr. Nikola Tesla described in a magazine article the remarkable effects upon himself and his assistants resulting from their exposure to the action of alternating currents of exceedingly high-voltage and frequency during some research work. He prophesied that when electrical oscillations were fully understood and applied by physicians that a *universal healing agent* would have been obtained—one which would so increase the vital energy and resistive reaction of the human body as to enable it to throw off all disease. The present writer, acting on this hint, constructed a high-frequency apparatus, tested it on a number of patients and reported his results to a local medical society in 1895. So far as can be learned this was the first clinical work ever done with the Tesla Current, altho d'Arsonval in Paris was then experimenting with his relatively low voltage currents, produced from 3,000 cycle alternators. Later, Apostoli, Denoyes, and others reported remarkable results from the currents induced in the bodies of patients placed inside of huge solenoids or wire coils thru which high frequency currents were passing. The effects obtained were: increase of strength, appetite and weight, induction of natural restful sleep, and increase in tissue combustion and elimination.

Early in 1895 the author devised the first *Vacuum electrodes* for applying Tesla currents to the patient. To-day thousands of physicians are using this device, often *mis*calling it the Violet-ray Treatment. This is of course a misnomer, the violet light in the tube having nothing whatever to do with the healing effect produced by the transmitted electrical oscillations.

A Striking Electrical Autograph of the Tips of the Four Fingers and Thumb of the Author's Left Hand. A High Frequency Current Charged the Hand while It Rested on a Photograph Plate, With the Results Shown.

(*Continued on page 831*)

See CC. 250 - 33 for next page.

Oxybenzylmethylenglycolanhydride

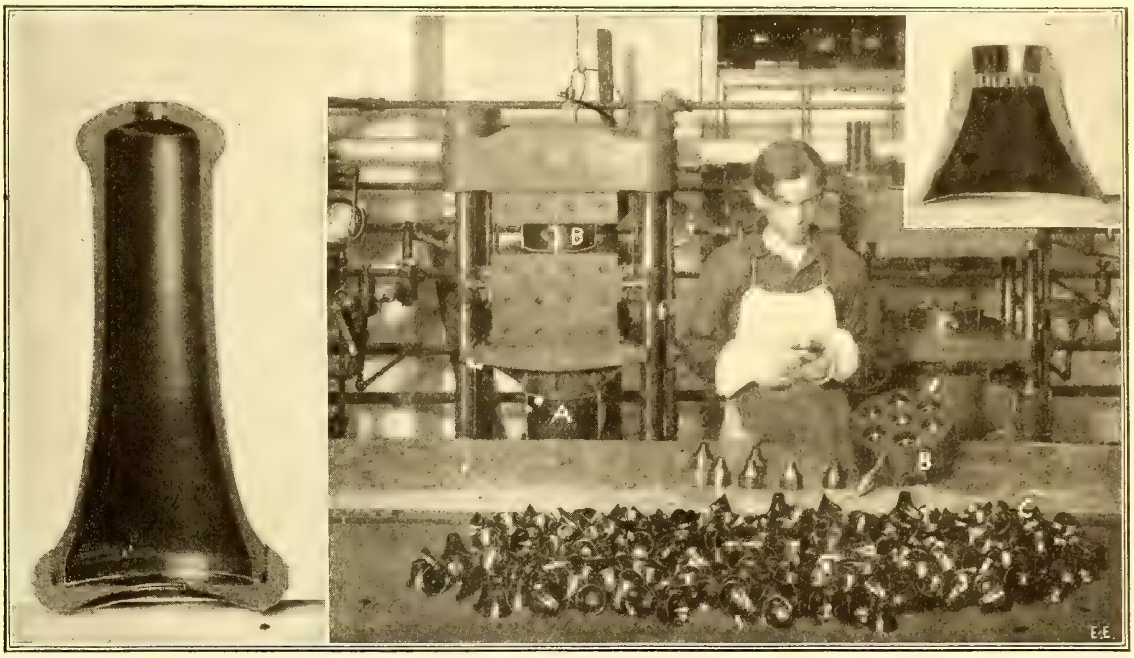
WITH a cunning surpassing that of the alchemist of old, the modern chemist combines two strong-smelling liquids to form a solid that is utterly devoid of odor or taste. Under conditions known to that deft magician—the chemist—those two odorous and unpromising materials, carbolic acid (Phenol) and formaldehyde, unite and form a transparent, amber-like solid (Oxy-benzyl-methyl-englycol-anhydride), better known as BAKELITE.

Bakelite is a condensation product of carbolic acid and formaldehyde. In its final form it is a hard, amber-like substance, having none of the chemical characteristics of the raw materials from which it is made.

Bakelite has no melting point, but at temperatures in excess of 575°F. (300°C.) gradually carbonizes and disintegrates. It is not merely a mixture, like compounds of rubber, shellac, or resin, which have characteristics of their components. Bakelite is an American invention, the process having been originated by Dr. L. H. Baekeland, already widely known by his discovery of so-called *gas-light* photographic papers, notably Velox.

Moulded Bakelite finds great favor in the electrical field as an insulating material—it is hard and strong, has great electrical resistance and successfully withstands high temperatures. Water, steam, oils, solvents and most chemicals have no detrimental effect on it.

Exactness of shape and size is characteristic of Bakelite moulded insulation. Every piece comes from the die exactly like every other piece; the edges and lines are sharp and clean and the piece fits in place as in interchangeable machine construction.



The Illustrations Show from Left to Right—Section of a Moulded "Bakelite" Telephone Receiver Shell; Process of Moulding "Bakelite" Transmitter Mouthpieces, "A" Being the Hydraulic Press and "B" the Multiple Moulding Die; Upper Picture Shows Section of a Mouthpiece.

Because of its permanence and chemical inertness, this new insulator is the ideal material for electrical instrument construction. No acid-sulphur compounds are emitted as in the case of hard rubber, nor does Bakelite turn green, or bloom. The finish, too, is all that can be desired—it comes from the mould with a beautiful lustre and with every detail and relief sharp and clean; o buffing is necessary.

This remarkable insulation meets every requirement for moulding in metal inserts. The inserts are in to stay, securely and accurately positioned when the piece comes from the mould. To put metal inserts in hard rubber or fibre requires drilling, tapping, and fitting—slow and expensive processes. Moulded Bakelite can readily be machined and polished. Each of the standard colors—brown, red, and black—is rich and handsome in appearance.

Bakelite has many valuable qualities which make it especially suitable for mechanical pieces, sometimes made as die-castings. It is strong and light—weighing only about one-third as much as die-castings and has a specific gravity of 1.35. The beautiful finish is permanent; there is no enamel or other surface coating to wear off, no plating or japanning. It is more-over extremely homogeneous, the same all the way thru. Unlike many die-cast alloys, Bakelite does not lose its mechanical strength nor deteriorate with age. In a critical time test with a gear made from Bakelite-Micarta driven by a steel pinion, practically no wear was evidenced after 20 months' service. The speed of the special gear varied from 560 to 1100 r. p. m.

The new insulation in the form of sheets, rods, and tubes is fast taking the place of hard rubber, fibre, pressboard, and similar materials. It combines high dielectric strength and heat resistance with unusual mechanical strength. It is hard, tough and homogeneous and fairly flexible. Supplied in sheets, rods and tubes of standard sizes it can readily be machined to any required form. Standard colors are brown and black.

Telephone apparatus has benefited greatly by the advent of Bakelite. The accompanying illustrations show a sectional view of a Bakelite receiver shell as well as a section of transmitter mouthpiece. The machinery shown comprises powerful hydraulic presses which press the dies together and thus form the accurately shaped mouthpieces seen on the bench in front of the operative. Here "B" represents the die, "A" the hydraulic press, and "C" the moulded mouthpieces.

The new Bakelite receiver shell is without a doubt the most perfect receiver shell to-day. It is a great improvement over the old style hard rubber and composition shells and has none of the disadvantages of either. It will not turn green from age or lose its lustre. It will last indefinitely, which helps to reduce maintenance cost. Not only are the receiver shells made of this material but the mouthpieces and certain other parts are made of it as well. The mouthpieces can be washed and thoroly sterilized as moisture, acids, or steam leave no effect on Bakelite.

The general physical properties of Bakelite moulded material are given below. They vary according to the composition used.

Specific Gravity: 1.33 to 1.89.
Temperature Resistance: 300° F. to 400° F.
Dielectric Strength (average): 250 to 425 volts per mil.
Tensile Strength (average): 3700 to 4500 lbs. per sq. in.
Colors: Dark brown, reddish brown and black.

An important form of the insulator is known commercially as Bakelite-Dilecto. This hard, marble-like material, which is much used for switch panels, especially on wireless sets where the very best of insulation is demanded, has an average dielectric strength of 700 to 1,150 volts per mil (1 mil equals .001 inch) according to thickness. The insulation value increases somewhat at temperatures up to 212°F. Sheets approximately ⅛ inch in thickness have been repeatedly tested in excess of 100,000 volts.

Bakelite-Dilecto will not expand, contract or soften under the influence of heat, even up to the point of carbonization. It is not inflammable, like hard rubber or resinous materials, but will eventually support combustion if brought into contact with a flame for any length of time. It will, however, continuously withstand a temperature of 300° F. without deterioration. It cannot be moulded but is supplied in a number of special shapes for certain requirements, such as sheets, rods and tubes.

Regarding the insulation resistance of Bakelite-Dilecto, the following data will prove of interest.

FOUR SAMPLES TESTED, 3/16 INCH THICK.

	Resistance of sample Megohms	Specific insulation resistance Megohms per in. cube	per cm. cube
	Normal Condition		
1	37,000	530,000	1,350,000
2	30,000	440,000	1,110,000
3	29,500	425,000	1,080,000
4	29,000	420,000	1,070,000
	After heating at 104° F. for 24 hours.		
1	260,000	3,700,000	9,500,000
2	102,000	1,500,000	3,800,000
3	190,000	3,750,000	7,000,000
4	128,000	1,850,000	4,700,000

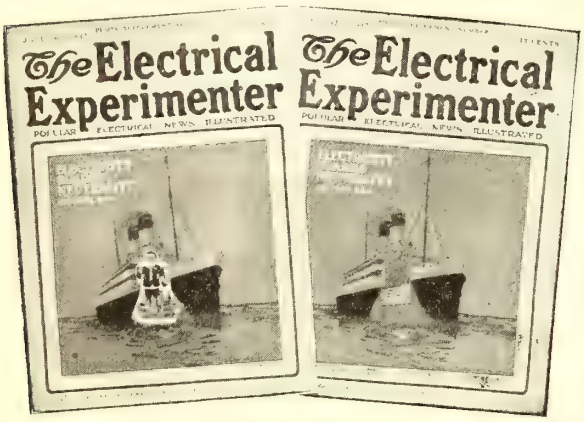
It is vitally interesting to note the increased resistance at the higher temperature. (1 megohm equals 1,000,000 ohms.)

Comparison with ordinary and well-known insulators is the criterion that shows where Bakelite stands in the electrical world. Note the last column at the right in the above table and then note that:—Hard rubber shows 2,000,000 megohms per centimeter cube at normal temperature; mica, 3,000,000 megohms cm. cube, gutta

(Continued on page 851)

Patriotism

BEFORE we go further, we might as well admit it. When it comes to front covers, THE ELECTRICAL EXPERIMENTER is on deck with a whoop. Whoop with a big W. As for noise—yes we don't deny it—our average cover designs, outnoise the biggest 1917 Model Klaxon. Now, of course, we fully realize that our cover designs are loud and are trying their level best to outshriek all other noisy covers on the crowded news stands. But you buy them, don't you? So do thousands of others every month who had never before heard of the magazine. They are attracted by the bright sometimes screaming colors. If at all interested, the net result is a new reader. As the bulk of our readers are news stand buyers, it naturally follows that we wish to attract the greatest possible amount. Our covers seem to accomplish this successfully, it would seem so, for in three short years THE ELECTRICAL EXPERIMENTER has reached a circulation of 73,000 copies, larger by far *than that of any other two electrical periodicals combined.*



Pasting Santa Claus Stickers Over the Stars and Stripes Is Not a New Fad, Nor a New Christmas Wrinkle in Dear Old Massachusetts. It's the Law. Goods Displaying Our Flag May Not Be Sold in This State.

So you see that the Editor's main and staple vice—E.E. Front Covers—is pardonable. He lays awake nights waiting for inspirations (or shall we say conspirations) and given six good ideas he will pick out the most startling one. Being that all the "good" ones strike him between 12 A.M. and 4 A.M. his friends, when out of earshot (as well as other shot) call the ideas nightmares! When a particularly "hot" one makes its first appearance by setting fire to the news stands, intimate friends are wont to call around at the Chief's office with such comments as: "Listen H.G. what dope do you take now before going to bed?" or "I thought opium smoking was taboo; *where did you get yours when you 'created' that latest masterpiece.*"

Or else someone calls him on the wire and informs him that the S.P.C.A. threatens to have him arrested. "S.P.C.A." shouts the chief in the phone, "what in thunder have I done now to an animal?" "Animal my eye" chuckles the other party, "S.P.C.A. stands for *Society for the Prevention of Cover Atrocities!!*" and so on.

But we did not start out to tell you about all this; rather we wanted to say that our weirdest covers as a rule only draw favorable comments, presumably because they make people think, hence are really useful, despite the loud colors.

Now then our January cover was really a very artistic affair. One of the sanest as well as best executed covers we ever had. Being such, it goes without saying, that H.G. had *not* concocted it. Rather, a very eminent artist conceived and executed it, namely Mr. John A. Bazant. Yes, the same Bazant whose design won the 2nd prize of $500 at the recent prize contest of the Society for Electrical Development where 800 paintings and drawings had been submitted to the judges.

Despite this, strange to say, our January cover called forth more unfavorable comment than any other cover we ever had. Beginning with the first day after publication, sarcastic letters began to pour in, asking us if we had ever seen the American flag painted backwards. Others wanted to know if the Germans would respect the Stripes and Stars, being that this was a brand new kind of flag. Still others lambasted us with the argument that the flag made for *backward* neutrality!

Of course all these good people were wrong. Moreover they probably were "landlubbers." For the flag *is* painted right. Just imagine a flagpole on the flag, the whole set in the bow of the ship. Will it not then appear exactly as Mr. Bazant painted it. You see when you look at the starboard side of a moving ship, any flying flag of the Stars and Stripes appears backwards.

The next surprise came from Boston, Mass. As a matter of fact, there were quite a good many from Massachusetts. Irate readers wanted to know what we meant by pasting Santa Claus and other paper stickers over the United States flag, thus hiding it. Since when are we ashamed of our Flag, and if we did print it, why did we cover it up? The argument was perfectly logical and was backed by facts. Our illustration of a copy of the "E. E." sent to us from Boston proves it amply.

Alas, these good people who thus wrote us wrathfully, did not know the patriotic laws of their fair and enlightened state.

For, gentle reader, in case you have not heard of it before, Massachusetts, a most learned and civilized state of these United States has among others a cute little law which forbids all humanity and others from openly selling any object whatsoever on which the Stars and Stripes are displayed. Whether the object be a Magazine, or a Bible, or a box of cheese, matters little. Don't ever dare to put such objects in a window display. The Massachusetts police will make you take it out or else arrest you. Pretty little idea that, to create patriotism in one's breast. And all this in highbrow Mass!

But perhaps you don't get the correct "drift" from our prose. For that reason we are moved to poetry which will make everything plain as a plane:

MASSACHUSETTS FLAG SONG

Tramp, tramp march the Cops
Licking their chops.
All is hunkydory,
If you hide Old Glory.
But don't wag,
The Old Flag.
If you do
Woe to you.
Says the cop:
"Now you stop
If the flag is here on sale,
You must go to jail.
If the flag is on your Bible,
You'll be pinched for libel
If the flag is on a postcard
Or if it's on the go-cart.
If the flag is here on sale,
Come with us to jail.
If the flag is on a postage stamp,
Or if it's on your auto lamp,
Perhaps it's on your letterhead,
Or printed on your cigarette
If the flag is here for sale,
You'll be put to jail.
If the flag is in your straw-hat,
Or if it's on your baseball bat,
If on baby's sand tin-pail,
Rightaway you go to jail.
If it's pressed into your soap,
Or on the label of your "dope"
If it's on ten dollar bills
Or on a box of bitter pills
If the flag is here on sale,
Pay the kale or go to jail.
That's the law in dear old Mass
Come along, you're pinched, my lass.

UNIQUE ELECTRIC TOY ENGINE.

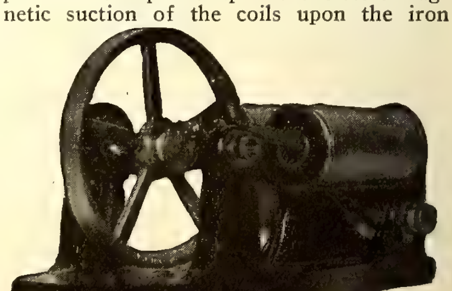
A unique electric toy engine of exceptional power has been developed recently by Mr. Thomas H. Phillips and is shown herewith.

The general construction of this miniature prime-mover, so dear to every boy's heart, is quite different from any of those with which we are already familiar, i.e., a pure solenoid action is utilized in this machine similar to an actual steam engine, whereas the others employ ordinary solid core magnets acting inefficiently upon a flat iron armature. Another feature of this engine is that it has no dead center and will start every time, irrespective of the position of the connecting rods and crank shaft.

It consists of two solenoids, each of which contain two coils, wound side by side, but separated from each other by an insulating washer. The cylinder is made from brass tubing and fitted with iron rods constituting the pistons which are joined to the flywheel shaft by means of connecting rods.

The four coils which make up the two main solenoids are connected in such a manner that each one of them act upon the piston at certain definite periods. The two forward coils are connected in series and their terminals linked to the battery binding posts of the engine. The remaining four wires terminating from each coil are connected to a set of four fixt segments, which are placed on the left hand shaft support. These are made from brass and placed in circular order. The shaft carries a brush which plays over this fixt commutator, so as to connect the necessary coils progressively to produce rotary motion of the shaft. The connection to this brush is made thru the frame of the engine.

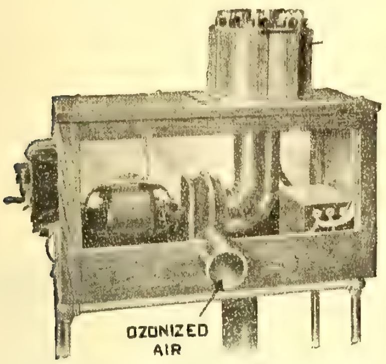
The operation of the engine is very simple and it depends upon the electro-magnetic suction of the coils upon the iron pistons. This is of course accomplisht by the manner in which the coils are connected to the fixt commutator. The engine runs very fast on a single dry cell.



A New Toy Electric Engine with Double Wound Coils, That Is Extremely Powerful.

A NEW OZONE MACHINE OF MANY USES.

The ozone machine shown herewith consists of a main frame of preferably aluminum, constructed with annular end pieces



Ozone Machine for Alternating or Direct Current. A High Tension Transformer Discharge Produces the Ozone, which Is Blown Out Into the Room by a Motor-driven Fan.

which are provided with slots extending inwardly from the periphery of the rings toward their centers. These annular end pieces or rings are held together by longitudinal bars. A series of comb-like electrodes are arranged to fit in the slots. The electrodes consist of a strip of conducting material, and have a series of laterally extending teeth. When these electrodes are placed in the slots the ends of the teeth will lie in the same distance from the center of the rings. The electrodes are held in place by means of rings which fit over the annular end pieces. The *di-electric* is a thin glass tube. Within the tube, at a short distance from each end, is an insulating washer. On each end of the tube is a cap made of insulating material. Between the washers the tube is filled with a finely-powdered conducting material. A metal conducting rod extends thru the tube from end to end, with the ends of the rod threaded to receive nuts which hold the caps in place. The rod forms one terminal, to which one pole of a high tension transformer is attached, the other pole being connected with the frame which holds the electrodes. The dielectric prevents sparking between the teeth and the electrodes and the conducting material, but it permits a static discharge thru the glass in the form of a glow or fine brush. The ozone produced is blown out into the room only by a motor-driven fan of special construction.

AIRSHIPS USE WIRELESS SUCCESSFULLY, SAYS MARCONI.

Upon his return to London from Italy, Dr. Guglielmo Marconi, in an interview with British journalists, gave the following information: "New developments will not only make wireless communication in this war more efficient than ever before, but will make it more difficult for the enemy to intercept messages. These improvements will apply to instruments in aeroplanes and airships. Hitherto aeroplanes have been at a disadvantage with airships in wireless work, for altho they were able to transmit messages, they have not been able to receive them. This was because the received signal was too faint to be distinguished, being drowned by the noise of the aeroplane engine. Now we have been able to strengthen the received signal sufficiently to enable messages to be taken."

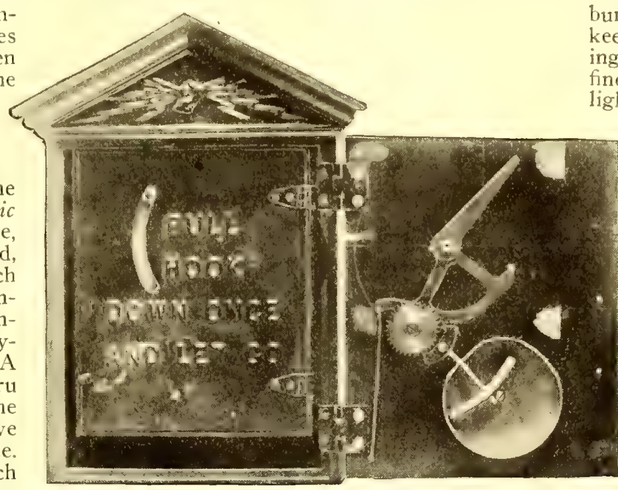
FOOL-PROOF FIRE ALARM BOX.

The accompanying view is that of a fire alarm attachment invented by James P. McLaughlin, which it is proposed to place on the Fire Alarm signal boxes in Philadelphia.

The scheme as shown is a direct acting, keyless door with alarm attachment. The operating lever, shown on the outside of door, has an extension arm on the shaft extending thru the door. When the outside lever is pulled down, the extension arm engages the hook which operates the box mechanism and when pulled to the full downward position, enables the apparatus to deliver four rounds of the station code number.

The shaft on the pulling lever has a rack also attached to it, which, when operated, causes the bell-striking alarm attachment to operate thru a pinion and escapement. The alarm is given by the pulling down of the lever and also on the return of the lever to its original position, propelled by a strong spiral spring attached to the rack.

This scheme is mounted on the original door of the boxes, and while it does not prevent the sending in of malicious false alarms, it, when operated, produces sufficient noise to at least discourage such practise and may attract the attention of some one standing near it, making possible the apprehension of the maliciously inclined person operating the box.



Novel Fire Alarm Attachment That Rings Gong Shown when Box Is Operated. Intended to Discourage Sending in of Malicious False Alarms.

SECRETARY DANIELS' REPORT ON NAVAL RADIO SERVICE.

The name of this service will be changed to naval communication service in the near future, it having taken over the handling of all telegraph, telephone, and cable communications and generally all dispatch work of the Naval Service outside the fleet, in addition to the work of the radio stations, says Secretary of the Navy Daniels in his annual report. The Government and commercial needs have been efficiently served. As an illustration of the growth of the Radio Service in the past few years it may be noted that during the period from December 13, 1912, to December 31, 1913, there were handled a total of 12,854 commercial messages, while during the past fiscal year 97,084 commercial messages were handled. The number of official messages had correspondingly increased, the number for the fiscal year being 628,997.

The Tuckerton and Sayville Stations have been successfully operated under naval control during the year with great profit to the owners.

There are 51 radio stations of the service in operation ashore and on light vessels, 2 of which are high-power stations, 10 of medium power, and the rest of lower power, for communication with ships. In addition, a new medium-power station has been completed and will soon be put in service at Point Isabel, Tex. This station will be of great service to the merchant marine in that section, as well as to the Government in facilitating communication with vessels in Mexican waters. Within the next year it is expected that at least two new high-power stations will be completed, namely, at San Diego and at Pearl Harbor. Work is progressing satisfactorily on the Cavite high-power station, also on medium high-power stations at Puget Sound and at Cordova, Alaska. Estimates have been submitted for another high-power station on the island of Porto Rico, primarily for use in naval operations.

Marked improvement has been made in the radio equipment of ships and of the more important shore stations, enabling wireless communication to be maintained over greater distances and securing an unfailing means of cross-continent communication at all times. Distant control stations have also been established at the principal stations.

AN ELECTRIC HEATER FOR AUTO ENGINES AND CARBURETORS.

The purpose of the new engine and carburetor electric heater here shown, is to keep the engine and carburetor warm during cold nights. Every private garage will find it useful. It is attached to any electric light socket and placed under the hood—on the engine and as close to the carburetor and manifold as possible. If the weather is severe, blankets should be placed around the hood to hold in the heat. Generating just enough heat to keep the engine, carburetor and radiator slightly warm, it eliminates starting trouble with its resultant strain on the starting batteries and the wrapping of hot cloths around the manifold and carburetor to cause the gasoline to vaporize properly. Moreover, it saves the wear and tear on the engine caused by cold oil.

The body of the heater contains a rugged heating element which consumes one-tenth of a kilowatt—less than one cent an hour in cost. This element is enclosed in a black metal shell—shaped like and about the size of an ordinary dry cell—which is perforated to allow for the circulation of heated air from within. The outfit weighs less than one pound and is equipt with ten feet of cord and an attachment plug.

Extremely Useful Device for All Motor Car Owners—an Electric Heater for the Engine and Carburetor.

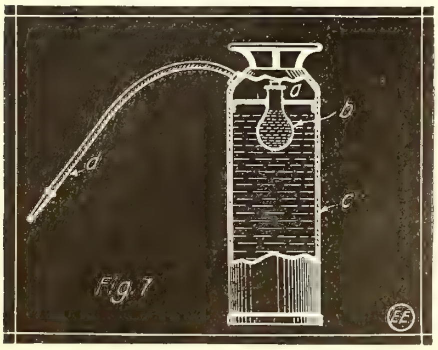
Experimental Physics

By JOHN J. FURIA, A. B., M. A.
Instructor in Physics and Science Master, Riverdale Country School

LESSON TWO.

Explosions and Explosives (Concluded).

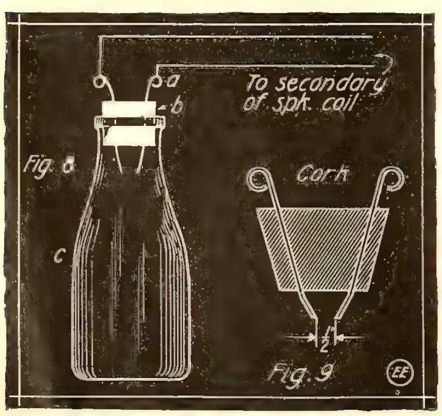
IN the last lesson we noted that for any gas whose quantity is always the same, the pressure it exerts multiplied by the volume it occupies is always the same. (*Boyle's Law.*) Also, whenever in a given volume we have a greater amount of gas than usual, the gas exerts a large force and the greater the compression the greater the force.



A Typical Example of Gas-energy Apparatus—the Fire Extinguisher, in Which Sulfuric Acid Mixing with Bicarbonat of Soda Solution Generates Gas. This Forces the Solution Out of the Hose "D."

Let us define an explosion making use of the results of Lesson One. We have an explosion whenever we have a gas under such great pressure that it bursts its container. It is the tendency of forces to seek equilibrium that causes the explosion. Hence the first prerequisite to an explosion is *a large amount of gas occupying a small volume.* This large amount of gas in a small volume exerts a tremendous force and when the force is great enough to burst the container we get an explosion. In some cases we may cause a large amount of gas to occupy a small volume by compressing the gas. This is the physical means of doing so. The chemical means, which we shall discuss later, is generally to transform a solid or liquid into a gas, which process because of the lightness of gases, causes a large volume of gas to appear in the small volume which the solid or liquid occupied.

Experiment 4. Dissolve a little bicarbonat of soda in water. Drop a little concentrated sulfuric acid in this solution carefully by the aid of a fountain pen filler. A gas is formed rapidly. Suppose this experiment were performed in a closed vessel. Obviously the gas formed would exert greater and greater force as more and more gas was formed as this would be concentrating the gas in the given volume. The ordinary fire extinguisher is a piece of apparatus making use of our fundamental principle of explosions. (See figure 7.) (c) is a metal cylinder nearly full of water; (b) is a bottle fastened to the sides of the cylinder and containing sulfuric acid. Bicarbonat of soda is dissolved in the water in (c); (a) is a stopper which fits loosely in the bottle (b). When the extinguisher is inverted, the sulfuric acid gradually mixes with the solution and forms a gas. The tremendous pressure of the gas forces the solution out thru the hose (d) and some of the gas itself comes out also. Both the water and the gas extinguish the fire. Since the bottle containing the sulfuric acid is fastened upright, the acid cannot mix with the solution unless the apparatus is inverted so as to release the stopper.



To Demonstrate How a Gas Explodes Violently, Fill a Milk Bottle with an Inflammable Gas. Pass an Electric Spark Between the Cork Wires, When the Cork Will Be Blown Out of the Bottle.

IN THE APRIL "E.E."

A new electrical scheme for detecting submarines or sunken wrecks—an idea that may be of inestimable value to Uncle Sam.

The "Strong" High Frequency Apparatus and its application to electro-therapeutics, by Dr. Frederick Finch Strong.

The Aeroplane of To-day—how electricity starts the engine, lights the cabin, provides telephone service and automatically stabilizes the machine while in flight.

Baron Münchhausen's New Scientific Adventures, by Hugo Gernsback.

Electricity in its application to motor-boats.

The R-ray—a new discovery in medical electricity, by H. Rosenthal.

Gases and the Atmosphere—Third paper of the new series—"Experimental Physics" by John J. Furia, A.B., M.A., F.K.S.

Construction of a small direct current generator—suitable for lighting lamps and running numerous other apparatus, by George Sturley.

Receiving the Marconi High-Power Stations with the Oscillating Audion, by Samuel Curtis, U.S.N.

The How and Why of Radio Apparatus—Part 4—The Spark Gap.

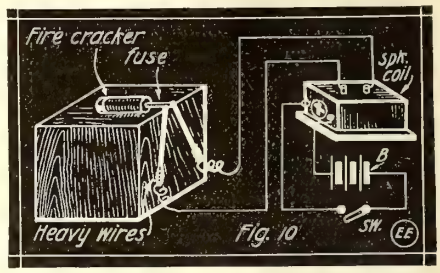
The Measurement of Inductance. Part 2 of a series on this all-important and timely subject, by H. Winfield Secor and Samuel Cohen.

The Coast-to-Coast Amateur Radio Relay (Washington's Birthday Relay), by W. H. Kirwan, 9XE.

Electro-plating Mirrors by a New Vacuum Process.

Experiment 5. If you own an automobile or a Ford and run it over some glass, nails, etc., you will notice that an explosion occurs as the tire is punctured. If you do not own an automobile inflate a toy balloon and puncture it. An explosion will occur. The gas in the automobile tire was under tremendous pressure and the tire was strong enough to withstand the force, but when the tire was slightly ript by the glass, it was no longer able to do so and the explosion occurred. The air inside the tire (or toy balloon) rushing out to get into equilibrium with the rest of the air around it, was the explosion. Note that a large amount of gas in a small volume was the beginning of the cause of the explosion.

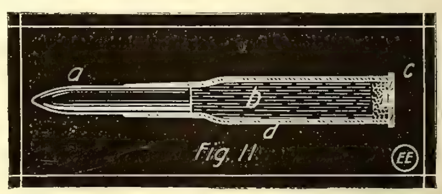
Experiment 6. Blow up a paper bag. Strike a friend on the back with it and notice the explosion. After blowing up the bag the air in it is not compresst. It has the same pressure as the surrounding air, but on striking something with the bag, there is a tendency to make the air occupy a smaller volume; its pressure is increased, and the bag bursts with an explosion. (The author learned to perform this experiment in school when the teacher was not looking.)



A Safe and Sane Way in Which to Ignite Fire-crackers—a Small Spark Coil, Battery and Push Button Does the Trick.

Experiment 7. In order to understand chemical explosions, the reader should weigh some iron filings, heat them and weigh again. He will find, if he has sufficiently sensitive balances, that the iron gains weight. The explanation is that the iron filings combined with something from the air (a gas named oxygen) and thus increased in weight. In like manner we can heat certain other substances and have them do the reverse of this, i.e., give up some of the gases on heating. That is the principle of explosives. An explosive is a substance which by heating or percussion can be made to give up gas which is combined with it. This gas suddenly formed in a small volume gives an explosion. Gunpowder, dynamite, nitro-glycerin, etc., all contain gases which they give up on exploding.

Experiment 8. Strike several blows with a hammer and then feel the hammer. The hammer feels hot. The force of the hammer hitting creates heat. Hence if we have a substance that will give up gas on slight heating, striking it a blow will set it off and cause the explosion. It is therefore wrong to say that we light a firecracker, since the light does not cause the firecracker to explode. It is the heat that does it. Whether we produce the heat by an electric spark, by percussion, or by *lighting* is of little importance.



The Modern Rifle Bullet, Is Based on Explosive Action. The Cap Ignites the Powder "b," the Gas of Which Being Confined, Forces the Bullet "a" Out of the Gun Barrel.

Experiment 9. Procure a glass cylinder or bottle made of thick strong glass. Fit a cork stopper to it. (See figure 8.) If a

(*Continued on page 852*)

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

H. Gernsback, Manager *W. H. Kirwan, Master of Radio Relays*

The Washington's Birthday Relay, February 24, 1917

By W. H. KIRWAN, (9XE)
Master Radio Relays, Radio League of America

On the night of February twenty-fourth, every wireless amateur, as well as every member of the Radio League of America, will have the chance of his life to show the world how efficient he is and how much he knows about wireless. Mr. W. H. Kirwan, of wireless fame, has arranged for a double-barreled transcontinental Amateur Wireless Relay, that will set the country a-talking! On this memorable evening, a New York amateur will obtain a certain message from the mayor of the City of New York and this message (the contents of which will be kept secret until 9 P.M., February twenty-fourth) will be relayed over special amateur stations across the country, to be delivered to the mayors of the West Coast cities.

Simultaneously, another message will be handed to a California amateur by the mayor of Los Angeles, and this message will wing itself eastward, from one amateur station to the next, until it is finally delivered to the mayor of New York.

Only special amateur stations listed will do the actual sending. All other amateurs are strictly requested NOT TO SEND, but to listen in only: As soon as you receive the M.S.G. (message) rush it to the mayor of your city and get a receipt for it. Valuable prizes will be given for good and speedy work. February twenty-fourth promises to be an exciting evening for all Radio amateurs. We hope you will be on deck and let your motto be: "Watchful Waiting!"

SEVERAL criticisms recently made about the different relays arranged for by the writer, lead one to believe that the Radio Amateurs of this country are prepared for a final test of their skill in relay work. We have been trying in our small way to educate the workers up to the point where successful work could be done; while we admit many stations are relaying now satisfactorily, not until recently have M.S.G.s (messages) been relayed successfully from coast to coast. We have outlined a plan which will really be a true-blue test or race between amateurs and special stations, and while we appreciate the good work the special stations have been doing—my hat goes off to the amateurs who are the real men behind the guns in all relays.

We propose to try and send a M.S.G. from the mayor of New York City and deliver it to the mayors of the West Coast, using special stations going westward. We propose to try and obtain a M.S.G. from the mayor of Los Angeles and deliver it to the mayor of New York, using amateur stations only going eastward from the West Coast.

Every amateur in the country is asked to try his skill at receiving these messages and for heaven's sake please do not *send*—but *listen*, and you will have a bigger job and attain more valuable results and prizes than for a few minutes' sending. You all have a whole year for sending and we ask you to please try and quiet everyone in your state so that you may all try for a prize.

Any station not listed and sending in defiance of our most earnest request will be noted and his "call" publisht, as well as having his intentional interference brought to the attention of the Radio Inspector in his district. Now boys, we have spent lots of time on these preparations and have been busy working while you were peacefully sleeping, so please take out your *fuse plugs* on February twenty-fourth at 9 P.M., Eastern time and keep them out. A representative of every wireless organization in this country is working on this relay and we have old men and boys—amateurs and experts—and the Government authorities are watching closely all these tests—so don't get in bad by interfering, before you get a flying start in the game.

STARTING M. S. G. (MESSAGE).

All of you wisht for something hard on the other relays and many complained because they knew the M.S.G. ahead of time—so your wish is fulfilled now, you have the job of your life on your hands.

Our many radio amateur friends will undoubtedly be glad to learn that Mr. W. H. Kirwan has promised to write one article each month for a period of twelve months, for THE ELECTRICAL EXPERIMENTER.

W. H. Kirwan, Master of Relays for the RADIO LEAGUE OF AMERICA and known to the amateur world as 9XE, was born in Baltimore, Md., February 5, 1881. Graduated in Steam and Electrical Engineering in 1897; Brooklyn Polytechnic Institute. Six years in the U.S.N. fitted him for life's more serious work. Six years' study of law prepared him for the bar, but he took up Engineering instead. Was Assisting Erecting Engineer at the Panama Canal for the Emergency Dam machines, and has been in every civilized country on the globe that has a seaport. He has been a student of Wireless Laws since Marconi first flashed his signal across the Atlantic, and he has grown up with the new art. He is the author of the National Relays and the Q. R. M. League of the U.S. He is at present Superintendent of Construction for the Otis Elevator Co., in the States of Iowa and Illinois.

Mr. George C. Cannon of New Rochelle, N.Y., will start the M.S.G. from station 2ZK, on a wave length of 350 meters as soon after N.A.A. routine report on the night of Saturday, February 24, 1917, as becomes possible. Catch his "sigs" if you can. Mr. Cannon has agreed to act as eastern manager of this relay and Mr. Robert T. St. James, 1IZ, Great Barrington, Mass., and Mr. C. H. Stewart, 3ZS, St. Davids, Pa., will act as his right and left flanks to relay the M.S.G. one-half hour later south and north, so that all of you on the Eastern coast may get it, but these stations will not send it until one-half hour later than the time Mr. Cannon starts it, and no station other than these is asked to resend it until next day except 8NH. Write down the M.S.G. you receive—station sending—time to the minute and deliver a copy of it to the mayor of your town and obtain a receipt for it. This is important as you will see later. The other sending stations as listed will be worked in the order of the list and the preceding station will call the next station on the list and give him M.S.G. and Q.S.L. This station will call next station and so on down the line until station 8YO, Columbus, Ohio, receives the M.S.G. He will then call 9ZS, Springfield, Ill., Illinois Watch Co. If 8YO cannot get him QSA—let them send M.S.G. on Q.S.T. and 9ZN, Mathews of Chicago, W.L. 425 meters, will take M.S.G. and give it to 9XN, Grand Forks, N.D., and 9XV, Washington University, St. Louis, Mo. 9XN will give it to 9ZF, Denver, and get Q.S.L. 9XV will wait until 9XN has sent and if no Q.S.L. is received by 9XN 9XV will call 5ZC, Corlett, Dallas, Texas, who will give it to 9ZF, Denver, a station owned by Mr. Doig and aided by Mr. Smith of the Y.M.C.A. Radio Club of Denver. This station, 9ZF, will be flanked by 9XN on the north and 5ZC on the south, who will assist if necessary, if QRN is bad in trying to get M.S.G. thru to 6EA, Seefred Bros., Los Angeles, as has been done several times in some recent tests. 9ZF will have as a relay station if necessary 6DM, R. Higgy in Phoenix, Ariz., and also 6SH, our old friend MacQuarrie, at Stockton, Cal.

Our old standby, 7YS, St. Martin's College, Lacey, Wash., has promised to be on the job if we start it before his bedtime, so it will be up to 7YS to give it to Vancouver, B.C., and also to Seattle. This reinforcing or flanking of sending stations was necessary owing to the northern route thru Lewiston, Mont., and La Grande, Ore.,

(*Continued on page 848*)

Controlling Toys by Radio

ONE of the most spectacular and interesting electric toy outfits ever conceived was recently built by Mr. Thomas H. Phillips, of Brooklyn, N.Y. This novel and ingenious display consists of a large number of toys mounted on a platform and controlled by wireless waves produced by operating a spark gap excited by a spark coil. The radio controlled toyland is illustrated at Fig. 1. The transmitting apparatus is shown at the left, just in front of the child, who is manipulating the key The receiving and controlling apparatus, which are the most important features of the equipment, are arranged on the floor underneath the table. Fig. 2 shows the complete device; the receiving and controlling mechanism.

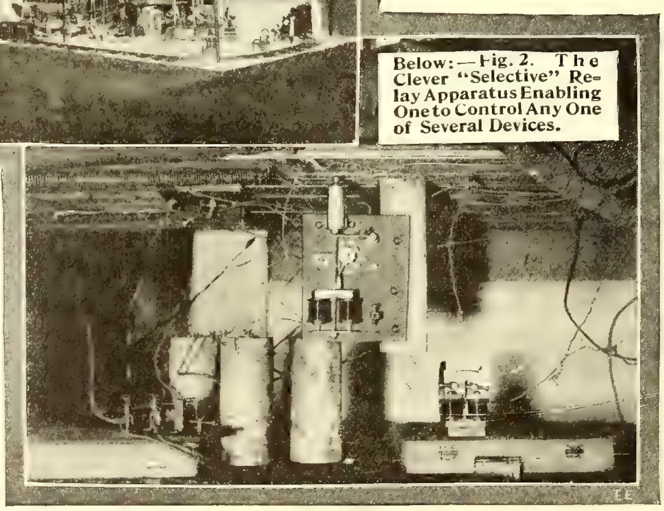
The controlling device is not of the *step by step* type, but of the *selective* type; that is to say, any toy (or other device) can be operated without interfering with the intermediate circuits of other toys. Thus, if it is connected to ten different toys, say in consecutive order such as (1) an electric train, (2) engine, (3) lamps, (4) merry-go-round, (5) spot lamp, and (6) electric fountain, it will not be necessary to connect first the lamps if it is intended to operate the merry-go-round or the spot lamp. In the step by step control system, it is of course necessary for the operator to connect the lamps before he can connect the merry-go-round. Altho the control switch is built along the lines of a step-by-step relay, yet by the addition of a time switch, the inventor makes it a selective device.

This switch is seen in the center foreground of Fig. 2. The two electro-magnets are connected to a polarized relay seen at the lower right-hand corner, which is controlled by a coherer shown in the left-hand corner. An armature is placed across the pole-pieces of the electro-magnets and is fitted with an extending rod. This rod is set free and permitted to move vertically, so as to act upon a ratchet wheel by means of an arm attached to the rod as shown. A switch lever which plays over a number of contact studs is attached to the ratchet lever. The time-control element is placed directly over the end of the movable rod and consists of nothing more than a small brass cylinder fitted with a piston. Just below the piston are two horizontal contact levers, which constitute the main circuit switch. These are normally open when the piston is well within the cylinder, being kept there when the electro-magnets are energized; but as soon as the lever is lowered the piston is released, thus causing the two switch levers to come together and close the main battery circuit. A definite time interval ensues before the piston falls, thus permitting the operator to turn the rotary switch (by radio waves) to the desired position before closing the main current circuit. The time interval is controlled by means of a check valve placed on top of the cylinder, which may be seen clearly in the photograph. A stop lever for the cogwheel is also provided to prevent the wheel from making more than a single connection at a time.

The complete wiring diagram of the apparatus as used by Mr. Phillips in his Christmas outfit is given at Fig. 3.

For the benefit of those who are interested in this work, the following details are given so that one may readily duplicate it. Furthermore the radio dabbler can use this type of relay to great advantage in controlling moving vehicles such as boats, submarines, torpedoes, etc., by means of radio waves.

Fig. 1. Inventor's Daughter Operating a Spark Coil, the Waves from which Actuate the Electric Toys Shown.



Below:—Fig. 2. The Clever "Selective" Relay Apparatus Enabling One to Control Any One of Several Devices.

Referring back to Fig. 3, the constructional details of the special relay are shown. The complete instruments are mounted on a base-board 8 x 5 inches. The cogwheel A consists of a flat brass disk containing ten notches which are made by carefully marking the perifery with a marking tool and filing down the teeth. A switch arm, B, is soldered to the wheel, the length of which will depend upon the distance of the contact studs from the center where the cogwheel is stationed. The wheel is mounted on a suitable shaft which is substantially fastened to the board. The cog is caused to rotate by means of a ratchet arm, C, which is held on a vertical rod as the reader will perceive. The lower end of the rod is fitted with an iron armature, D, which is acted upon by two electro-magnets, E, E. A guide-rod is attached to the end of each pole-piece, which passes thru a hole in each end of the armature. This is used for maintaining the rod in a straight position. Both electro-magnets are held together by a suitable yoke and a hole is made in the center for the control rod to pass thru. The stop lever, F, is made from brass and shaped as indicated. It is pivoted on the end of a brass pillar. This is accomplisht by a little experimenting. Before going on further with the construction, it is advisable that the instrument so far finished should be tested to see that the cogwheel is properly operated, when the electro-magnets are energized by means of a battery. The control rod should be held in place by means of an additional standard H.

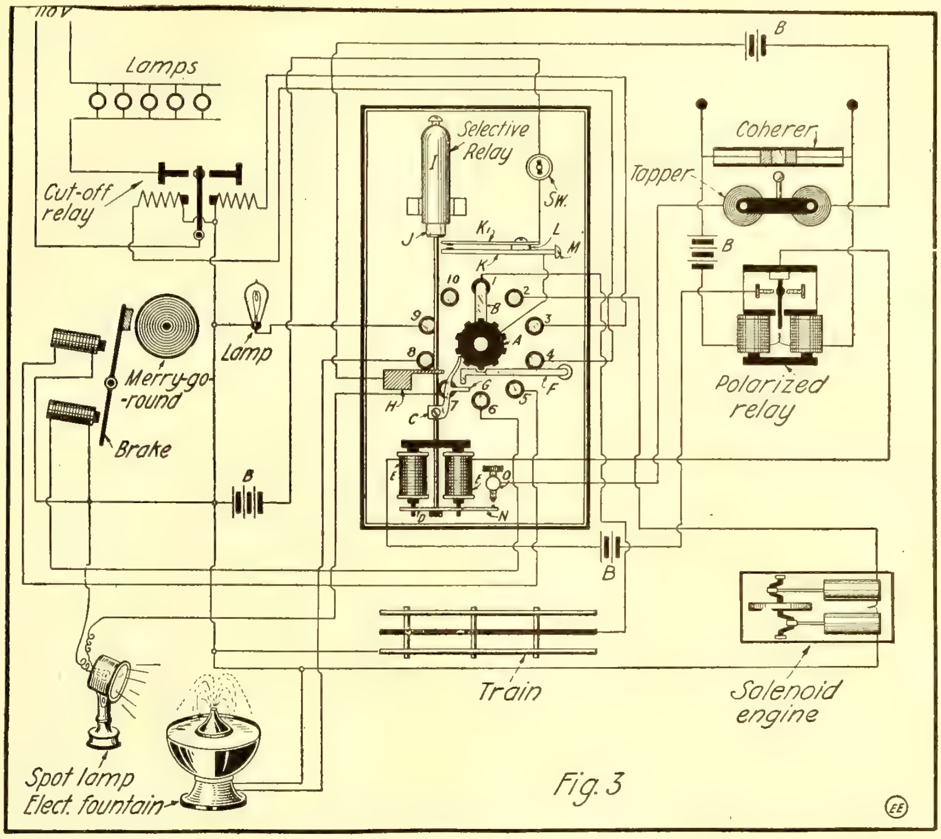
We now come to the most essential part of the instrument and that is the time-control attachment, which makes the complete instrument selective. This is indicated by I and consists of a steel cylinder about 2 inches long by half an inch in diameter. A three-eighths inch hole is bored in this, into which a piston, J, is set, which is about half an inch long. A great deal of care must be exercised to see that the piston fits very snugly in the cylinder and at the same time loose enough to permit it falling very slowly when it is entirely inside the cylinder. The air between the piston and the upper wall of the cylinder acts as a spring on the piston, so that when it is in, the air gently forces it back. It is advisable to insert an air valve on top of the cylinder so as to control and adjust the air within the cylinder. This will aid the operator to control the speed of the descent and ascent of the piston. The complete relay is mounted on top of the board in such a position that the control arm is just in the center of the face of the piston, as shown both in the diagram and Fig. 2. The relay control switch consists of a heavy brass plate, K and a flexible phosphor bronze spring, K_1; these are placed together, but separated by means of a hard rubber washer, L. Both are mounted on an insulating plate, M. When the piston J is up in the cylinder, the contacts should be open, but as soon as the piston falls, due to its own weight and the action of the air within the cylinder, the spring K_1 is caused to interlock with its mate, K, thus completing the electrical cir-

cuit as becomes evident from the wiring diagram.

An additional extension, N, is made on the armature, which is equipt with a contact on its end as indicated. This acts upon a stationary contact screw, O. These two contacts are used for completing the circuit of the *coherer tapper*, used for decohering the filings. This completes the construction of the selective relay and its success of operation will depend upon the manner in which the various parts are made and assembled.

The diagram of the complete connections is given in Fig. 3, and it shows a number of devices which have actually been controlled by this instrument, but the constructor may use the idea to control other toys or instruments which he may desire.

The transmitting apparatus may consist of a one-inch spark coil, large ball spark gap, key and batteries. The aerial and ground can be made of a heavy brass wire suspended from the spark gap terminals. A transmitting outfit suitable for this kind of work may be seen at the left of Fig. 1.



How the Various Apparatus, Such as Table Fountain, Lamps, Electric Engine, etc., Are Connected Up to the Novel Radio Control Relay Here Described. The Relay Operates on the Selective Principle.

The operation of the complete equipment is very simple; it is only necessary to acquaint one's self with the connections. Thus, if the operator desires to operate the solenoid engine (see Fig. 3) he must press the key twice, which will turn the switch lever B to the second stud. Suppose it is desired to run the electric fountain; he then presses the key six times; this will turn the arm B to the proper contact and connects the fountain. A few trials as to the operation of the complete equipment will possibly be necessary at first before one can master it. The operation is very simple and it will certainly repay the amateur for making such an equipment; it will give great fun and amusement, and at the same time prove immensely instructive.

WIRELESS BEDS.

An Annapolis midshipman named Dow is credited in local papers with an ingenious and useful discovery. He has found that ordinary bed springs make good wireless receivers. Having connected with wires the springs of his own bed and the beds of his two roommates, and attached an ordinary wireless receiver, Dow is picking up messages without any difficulty, especially those sent to and from Arlington station. It isn't even necessary, he says, to open the windows or to remove the bedding. The beds stand just as usual, serving their original purpose, and the occupants can amuse themselves as they lie abed by gathering in any messages that happen to be flitting about.

This looks like a more useful innovation than that of the Harvard student who attained fame by rigging up an electrical system to pull his window shades down when the morning light bothered him. Bedsprings are considerably cheaper and more accessible than the poles and wires usually thought necessary for wireless telegraphy. And there's bound to be a sudden boom in amateur wireless when Young America hears that he has a latent wireless plant right in his own bed.

(Midshipman Dow probably is unaware that the brass bed aerial stunt was fully described some eight years ago in *Modern Electrics!!*—Editor.)

KEEP WIRELESS FREE URGES PROF. KENNELLY.

Prof. A. E. Kennelly, of Harvard University, told the House Committee on Merchant Marine at a recent hearing that the Alexander bill for government regulation of radio stations is nothing less than an attempt to control the freedom of the air.

"The bill is just such a measure as Gen. Von Bissing might promulgate for Belgium, but is absolutely inconsistent with free institutions," he said.

"Designed as this bill is to protect the Navy from interference and disturbance in its communications, it would have the opposite effect," he declared.

Prof. Kennelly urged absolute freedom in the development of radio-communication thru every agency, rather than to place the whole science of wireless communication under government supervision.

Prof. M. I. Pupin, of Columbia University, also opposed the bill. "The wireless art is a promising and healthful young baby, which the proposed bill would take away from its lawful parents and place in a government institution," he said.

POWERFUL NAVAL RADIO STATION AT CHARLESTON, S.C.

Contracts have been awarded for all the construction work on the naval radio receiving station, which is to be erected at Charleston, S.C. It is to cost about $18,700 and the work to be completed within 150 days. A force from the navy yard is to prepare all foundations, which are to be of concrete. The contract for building the dormitory for the eight operators, the yeoman and the cook, and for the noise-proof instrument house, has been let to the Charleston Engineering and Contracting Co., all work to be finished within four months after begun.

The Pittsburgh-Des Moines Steel Co., of Pittsburgh, Pa., will construct the two tubular steel masts and the tower of latticed steel work, including the driving of piles and the anchorage work necessary. One hundred and fifty days are allowed for the completion of this. When all the actual construction has been completed the plant will be turned over to the Navy Department.

The contract for the building calls for the erection of a structure twenty-eight feet by thirty as a dormitory, and a single room nineteen feet by twenty-four to house the instruments. The latter room will be thoroughly insulated from the ground and from the surrounding atmosphere by several layers of non-conducting material built into the walls and doors. The four walls and ceiling will be lined inside with felt, instead of paper or other usual wall coverings, in order to make this insulation all the most perfect. Even the doors will be packed with non-conducting material and will resemble those of ice boxes. There will be no ventilation whatsoever by means of windows, and in order to supply the occupants of the instrument room with fresh air, an electrically driven fan will be used, forcing fresh air into the room from out of doors thru a series of baffles. A vent will be provided to permit the escape of stale air.

LOS ANGELES Y.M.C.A. WIRELESS GRADUATES.

Kenneth G. Clark, a resident of Los Angeles and a graduate of the Y.M.C.A. wireless school in that city, has just received his appointment from the Mexican government as "Ingeniero instalador de las estaciones inalambricas del Distrit," which, in English, means radio engineer in charge of construction. Mr. Clark will have supervision over the erection of a number of wireless stations in Mexico, beginning at Tia Juana within a few days.

Another graduate of the Los Angeles Y.M.C.A. wireless school, H. D. Hayes, organizer of the work and for four years principal, has been reappointed assistant United States radio inspector for the Pacific Coast for another three months, having received his first appointment to the government service last September. He is now stationed at San Francisco.

Courts have recently sustained the patents on Mazda lamps owned by the General Electric Company, and no further importations will be permitted.

DeForest *vs.* The Electrical Experimenter

A Recent Court Case Wherein the Experimenter Publishing Co. Defeated the DeForest Radio Telephone & Telegraph Co.

By H. GERNSBACK

ON September 20, 1916, in the Federal District Court of New York, before Judge Julius M. Mayer, the Marconi Wireless Telegraph Co. of America won their suit against the DeForest Radio Telephone & Telegraph Co. Judge Mayer ruled that the Audion was an infringement on the Fleming patent and the Marconi Company obtained a perpetual injunction against the DeForest Co. At the present time the DeForest Co. can no longer make and sell the regulation Audions.

Described in a few words, the Fleming patent covers: "A hot filament and a cold plate, both enclosed within an evacuated vessel." The de Forest Audion, as is well known, consists of the above elements, as well as a third additional member, "the grid," interposed between the cold plate and the hot filament. The simple addition of this grid—while admittedly giving better results than a valve without a grid—did not change the basic principle of the Fleming valve, and for that reason the Court ruled that the Audion infringed on the Fleming patent.

On the other hand, the Court understood the function of the grid perfectly with the net result that the Marconi Co. in its turn was enjoined by the DeForest Co. by a perpetual injunction from making or selling a valve containing a grid between the filament and a cold plate.

Now, then, before these injunctions had gone into effect, the DeForest Co., thru its attorney, Mr. Darby, in July, 1916, threatened to bring immediate suit against the Experimenter Publishing Co. if it did not at once desist from publishing certain advertisements, such as the ones displayed in the July issue of THE ELECTRICAL EXPERIMENTER. The advertisements complained of were the following: The Thermo Tron Co. of Los Angeles, Calif.; The Pacific Research Laboratories, of San Francisco, Calif.; The Jensen Electric Co., of Chicago, Ill., all of which were advertising three interior member vacuum detectors.

As will be noted, these devices contain "a heated filament, a cold plate and a grid interposed between the two former." The writer understood at once that the DeForest Co. was within its rights by asking the Experimenter Pubg. Co. to stop publishing advertisements of this nature. Accordingly the writer caused to be sent telegrams at once to the three manufacturers in question wherein the advertisers were notified that hereafter no tubes of the character named could be advertised in THE ELECTRICAL EXPERIMENTER.

That the EXPERIMENTER had kept faith with its promise is best demonstrated by the fact that in its September issue (the August issue had gone to press during the controversy) no three interior member vacuum tube advertisements have appeared.

The only vacuum tube advertisements carried since the September, 1916, issue were of the two member kind, which might infringe on the Fleming valve but never on the DeForest Audion.

It came, therefore, as a big surprise when, on December fourth, the DeForest Radio Telephone & Telegraph Co. served a voluminous bill of complaint on the Experimenter Publishing Co., charging the latter with contributory infringement and asking for extensive damages.

Qualifying as an expert Dr. Lee de Forest in his sworn affidavit accompanying the bill of complaint, made the following surprising statements:

"Again in November, 1916, my attention was called to the December issue of said publication, THE ELECTRICAL EXPERIMENTER, published by the defendant, and I found on page 602 an advertisement of the 'Tigerman Detecto-Amplifier' by the National Electric Manufacturing Company together with a cut showing a structure of detector which appears to be identical with the ones against which injunctions were issued in the suits of the plaintiffs against Myers, and the Audiotron Sales Company, et al., in San Francisco, and Alexander, and the Marconi Company in New York, and identical with the character of advertisements enjoined in the case against the Marconi Publishing Company in New York.

"I also noticed that on page 608 an advertisement appears showing a detector which is an infringement of the plaintiffs' patents, and in this advertisement the structure is called 'The Moorhead Tube' and offered for sale by the Pacific Laboratories Sales Department of San Francisco, Calif.

"I also found on page 594 of this issue an advertisement of the 'Lenzite Crystal Corporation' offering for sale a detector which is an infringement of plaintiff's patents, which is called the 'Lenzite Wireless Detector.'

"I also note on page 607 of this issue an advertisement of the Audiotron Sales Company of San Francisco, Calif., wherein an illustration is shown of the 'Amplitron,' the *new* 'Vacuum Detector-Amplifier-Oscilator,' which illustration shows a detector device identical with the structure which the said Audiotron Sales Company was enjoined from using, as above stated."

Now, then Dr. de Forest doubtless must have known very well that neither the Moorhead tube, nor the Tigerman tube, nor the Amplitron, *all of which clearly professed as being two interior member vacuum* tubes could possibly infringe on his patents. He knew this well, for he has no patent on a two member tube. Nevertheless he swears to the fact that these tubes infringe on his patents. Still let us give Dr. de Forest the benefit of our many doubts.

But now we come to the Lenzite Detector. The advertisement in the December, 1916, issue (on which the complaint is based) shows that this detector is a mineral detector, plain and simple. Its illustration shows it and anyone who can read English can not fail to notice that even the firm's name plainly reads: "Lenzite *Crystal* Corporation." The most cursory examination must also show to anyone, beyond the shadow of a doubt that this detector can not be a vacuum detector. Nevertheless the learned Doctor swears to it in his affidavit that the Lenzite Detector infringes on his patents. We are strongly tempted to charge the Doctor with bad faith, but on second thought, we prefer thinking that when he swore to that memorable affidavit, he felt in a humorous mood, reasoning no doubt that "A little joker here and then is cherished by the best of men."

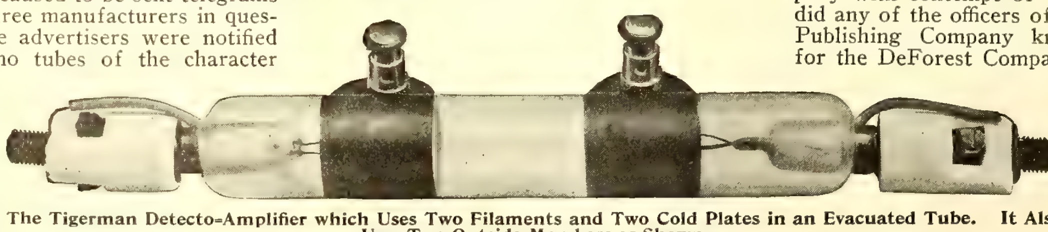
Why he just *had* to pick out the Lenzite detector, will probably remain an unsolved mystery for all time. Why he did not carry the joke further by claiming that the *"Crystaloi,"* the *Tel-Radion,* the Mesco *Universal Detector Stand,* and the *Micropho Detector* infringed on his patents we can't see for the life of us. This is surprising, for advertisements of these Detectors were all publisht in that fateful December, 1916, issue.

Now comes the comic opera part of the suit.

As stated before, the papers in question were served upon the writer on December 4, 1916. On the face of the summons the Experimenter Publishing Company was to answer on December twenty-fourth. But by an amazing oversight, Counsel for deForest neglected to fill in several important dates in an "order to show cause" attached to the bill of complaint. The net result was that on December eighth the DeForest Company obtained an injunction by default against the Experimenter Publishing Co., enjoining the latter from publishing advertisements such as the ones of the Lenzite people, on their crystal detector, as well as advertisements such as the ones of the Audiotron Sales Co., the National Electric Co., the Pacific Sales Laboratories, etc., all on two member tubes.

A few days afterwards the DeForest people having procured a copy of the January issue in which these very advertisements were publisht again, caused a new order to be served upon the Experimenter Publishing Company, asking the Court to punish it for contempt of Court for disregarding the injunction and thereby violating the dignity of the Court.

Here was a pretty mess. Remember, the Experimenter Publishing Company had till December twenty-fourth to answer the bill of complaint, nevertheless on December fourteenth an injunction was issued against it! Not till the papers charging the Company with contempt of Court were served did any of the officers of the Experimenter Publishing Company know that Counsel for the DeForest Company had been careless by forgetting to fill in dates on his paper.



The Tigerman Detecto-Amplifier which Uses Two Filaments and Two Cold Plates in an Evacuated Tube. It Also Uses Two Outside Members as Shown.

Making a long story short, the case came up for final hearing before Judge Mayer of the New York Federal District Court on January 13, 1917.

Counsel for the Experimenter Publishing Company was Mr. J. Edgar Bull. Mr. L. F. H. Betts seconded Mr. Bull. Mr. George A. Hoffman acted as general solicitor.

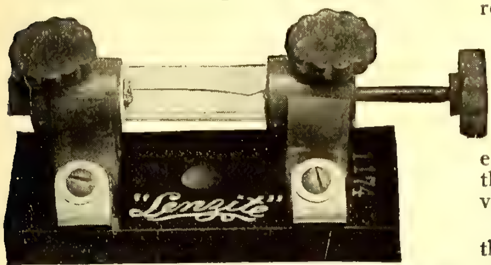
By that time Dr. de Forest woke up somewhat and before anything else was discust Mr. Darby formally withdrew the Lenzite Detector from the case.

The contempt motion was then argued at length and the writer, as well as the Experimenter Publishing Company, were charged with bad faith. Mr. Darby sug-

gested that in a case where the disregard of an injunction was far less flagrant than in the present one, the defendant had been fined $15,000 for contempt of Court!!

Judge Mayer, however, not only threw out the motion for contempt of Court, but the original injunction as well. For he held that the injunction order, because it was based on incomplete and faulty original papers served on the Experimenter Publishing Company, made the original order void.

Next came the arguments whether the



The Lenzite Crystal Detector Which Dr. de Forest Claimed Infringed on His Patents.

Experimenter Publishing Company had accepted advertisements which actually infringed on the de Forest patents.

Carrying out our promise not to accept advertisements of vacuum detectors containing a heated filament and cold plate and a grid interposed between the former, we consented to an injunction to that extent, but the exhibits before the Court were samples of the Moorhead tube and the Tigerman Detecto Amplifier having outside members.

Altho Mr. Darby insisted that the "outside member" acted in effect like a grid and therefore infringed on the DeForest patents, the Court ruled that this was not then established.

Our exhibit of the Moorhead Detector before the Court had only *two* members in a vacuous space. Our exhibit of the Tigerman tube before the Court embodied two of these Moorhead tubes joined end to end.

The Court refused to enjoin the Experimenter Publishing Company from accepting advertisements of these detectors.

This closes the case, which is of far-reaching import not only to the manufacturers concerned but to all wireless amateurs.

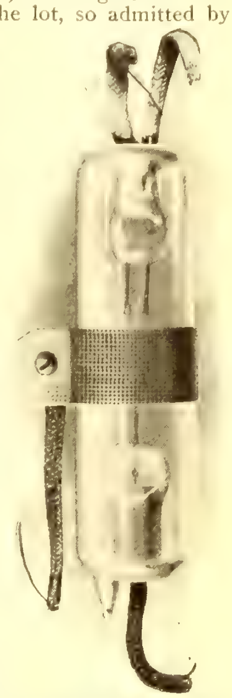
The deForest Company, no longer able to sell Audions to amateurs, tried by all possible, as well as impossible, means to stop the various manufacturers from making vacuum detectors, which they claim in no way infringe on the valid de Forest Patents.

Call it jealousy, discontent, or what not, the de Forest Co. went out upon the principle that if it could not make and sell vacuum detectors, no one else should. That by so doing they deliberately hurt the advancement of the art, as well as all amateurs, did not matter one whit. After it was found that the various manufacturers could not be stopt, except by large expense, the simple remedy of intimidating publishers was resorted to. For, it was argued, if the publishers of wireless and technical papers can be sufficiently intimidated, they will no longer take such advertisements with the net result that the manufacturers will be driven out of business.

The scheme worked admirably well with all of the technical, scientific and wireless papers—with the exception of THE ELECTRICAL EXPERIMENTER, the largest and the most influential of the lot, so admitted by de Forest himself. THE ELECTRICAL EXPERIMENTER feeling sure of its grounds, accepted advertisements right along of two member vacuum tubes and its judgment proved correct.

Thanks to THE ELECTRICAL EXPERIMENTER—as well as Counsel Bull, Betts and Hoffman—the Wireless Amateur as well as all others concerned, have not been deprived of efficient vacuum detectors—at least not for the present.

MORAL: Tu-be or not tu-be, that's the evacuated question!



The Moorhead Tube Employing Two Interior Members: a Heated Filament and a Cold Plate.

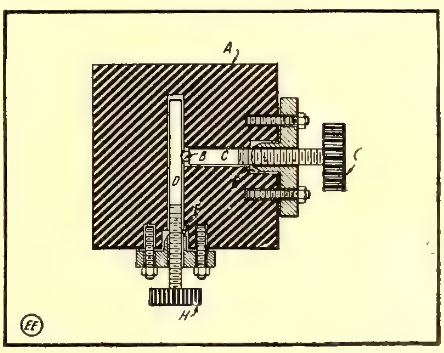
Consul Harry G. Seltzer, at Breslau, Germany, reports that one of the Breslau tinfoil factories has succeeded in providing a substitute for tinfoil by producing *zincfoil*. The new product is similar to tinfoil and is supposed to render the same services.

SPARK GAPS IN RUNNING LIQUIDS.

Dr. Eccles and Mr. Makower have experimented with radio sparks in running liquids. It was found, after using a variety of transformers and transformer ratios, that for large or small gaps, within the range allowed by the bore of the tube, much lower voltages were required to produce the spark in water than were required for an equal length of spark in air. In constructing apparatus it was ascertained that unless ample thicknesses of material were used, the pressures produced in the interior of the discharger during the passage of the sparks, were sufficient to burst it.

The most satisfactory design consisted of a cube of marble, with a side of about 4 inches, provided with a vertical channel of ¼ inch bore, thru which the liquids could be caused to flow; entering at the bottom and flowing away at the top, so as to sweep away all the gases formed by the passage of the discharge thru the liquid. The electrodes consisted of two horizontal metal rods, with axes at right angles, forming a spark gap in the middle of the liquid column. In order to prevent the liquid being forced out by the high pressure developed, it was necessary to provide stuffing boxes at the points where the electrodes entered the marble.

The illustration is a horizontal section of the discharger through the plane of the electrodes, and shows the marble cube A, with the liquid column B, in the center and the electrodes C and D, entering at right angles thru the stuffing boxes F and F, and provided with ebonite handles G and H, for adjusting the gap. The length of the gap was adjusted by rotating the handle G, and when the side of the electrode D became pitted, a new surface could be brought into action by rotating the handle H. Experiments made with water showed that if the water flowed too quickly, no sparking took place, and if the water flowed too slowly, arcing was produced instead of sparking. Even with the flow adjusted so as to give the best possible results, it was found that much energy was wasted, owing to the losses arising from the conductivity of the water. This makes the water-gap less efficient than an air-gap. Using transformer oil instead of water, an efficiency was obtained about the same as that of an air-gap. It was found that when the oil spark was used, with almost any degree of coupling, some impulse excitation was taking place. For example, when the coupling was 12 per cent, a single wave-length of 620 meters was observed in the primary and secondary circuits, and no other wave-length was detected; whereas when the spark occurred in air, the same circumstances gave two distinct wave-



Gratifying Results Have Been Obtained With Sparks Past Thru Oil and Water, the Gap Design Illustrated Comprising a Marble Cube With a Liquid Column Running Thru It.

lengths of 570 and 640 meters. The use of oil presents the advantages of giving better quenching than the air-spark and of eliminating the deafening noise associated with the latter, while the efficiencies of the two forms of apparatus are the same.

FULLER WAS FULLER.

The following little anecdote, while in order to bring out the point makes it necessary to use the actual names of the parties involved, is too good to let slide by on that account. A certain correspondence school, well known over the United States, recently had an exhibition booth at a certain state fair. One of their means of attracting attention was the installation of a wireless set, a rotary gap furnishing the noise necessary to draw a crowd. One of those connected with the exhibit went by that good old name of Fuller. He was a good sized sort of a fellow and chock full of puns, quips and jests, which were in the habit of coming forth at unexpected moments. Among the visitors at the booth, and a friend of the operator in charge of the set, was another wireless man, also by name Fuller. This Fuller, however, was not by any means of the generous stature of the first Fuller, being by several inches smaller. It happened that the two Fullers met in the booth at the same time, and the operator hastened to introduce them.

"Mr. Fuller, meet Mr. Fuller." As the two shook hands, Fuller the larger boomed: "Mr. Fuller, you're fuller than I am!" Fuller the littler looked highly indignant, as he is known to be of strictly temperate proclivities, and queried "How so?" Came back Fuller the larger, "Well, you're a little Fuller!!"

Now Fuller the littler is laying for Fuller the larger and it is expected that there will be a dual of wits when they again meet.

P. OARD.

THIS IS AWFUL

Said the wireless man to a friend of his, a bookkeeper for the company in which he worked: "Never go to sea during the stormy season. It would queer you with your company." "How so?" quoth the bookkeeper. "Why, you're apt to lose your balance," said the wireless man, as he ducked for the open doorway.

P. OARD.

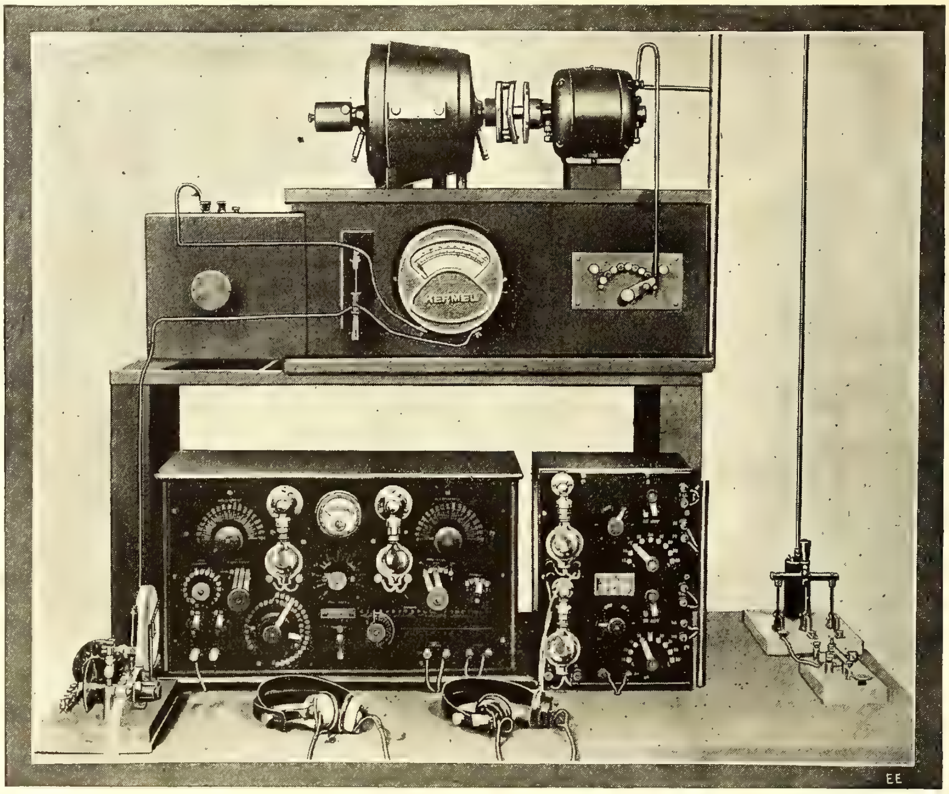
TRI-CITY RADIO LABORATORY.

Herewith is presented a photograph of the experimental radio station—9XR. This station, that of the Tri-City Radio Laboratory, Rock Island, Ill., has covered exceptional distances, both receiving and sending. The sending range on the Presidential Relay of October the 27th, was 1,085 miles. Our message was clearly copied at this distance, says R. Karlowa, operator.

Station 9XR is equipt with the *Hall Recording Relay* which permits the message to be copied on tape or read from a standard sounder. This is the only station in this country equipt with such a device to our knowledge. (The Hall radio relay was described in the "Latest Patents" columns of the February, 1917, issue of THE ELECTRICAL EXPERIMENTER.—Ed.)

All of the arc stations, as well as the spark sets, are daily being recorded by this device. Under satisfactory conditions the operators are able to record the German stations.

Besides two complete sets, one of which is shown in the photograph, 9XR is equipt with a wireless telephone set (Oscillion type) and a standard Federal receiving cabinet.



The Excellent Radio Set at the Tri-City Radio Laboratory, Rock Island, Ill. It is Equipt With the New "Hall Recording Relay," Which Enables the Operator to Secure an Accurate Copy of Every Message on a Paper Tape.

SENSITIVENESS OF THE EAR.

Rayleigh found the sensitiveness of the ear to sounds of different pitches to be as follows:

N	c' (256)	g' (384)	c'' (512)
s	6.0×10^{-9}	4.6×10^{-9}	4.6×10^{-9}

where s is the condensation (or rarefaction) in the air required to cause an audible impression, states Dr. Eccles in his *Handbook of Wireless Telegraphy and Telephony.* Here the condensation is the maximum which occurs during the course of a vibration. The method employed depended upon a knowledge of the rate at which energy was emitted from a resonator under excitation by a freely vibrating tuning-fork. In a careful re-examination of this question, Professor Max Wien, working with the telephone, finds not only a still higher degree of sensitiveness, but also a much more rapid variation with pitch, as shown by the following figures:

N	s	N	s
50...	1.14×10^{-7}	1,600.....	0.99×10^{-11}
100...	0.78×10^{-8}	3,200.....	0.90×10^{-11}
200...	0.71×10^{-9}	6,400.....	1.63×10^{-11}
400...	0.85×10^{-10}	12,800.....	5.7×10^{-11}
800...	1.63×10^{-11}		

In this table, N, indicates frequencies and s, condensations in c.g.s. (centimeter-gram-second) units. To test the question further, Rayleigh experimented in a new way, using metal cans maintained by electro-magnets as vibrators. The experiments showed that for equal audibilities, the condensation needed at pitch 128 is double that needed at pitch 256. In like manner the condensation needed at 256 was 1.6 of that at 512 per second. Finally, the condensation necessary for audibility at 85 per second was almost precisely double that for pitch 128: Confirmation was also obtained by direct comparison between the cans, of frequencies 85 and 256. Thus, to summarize:

N	512	256	128	85 per second
Relative value of s	1	1.6	3.2	6.4

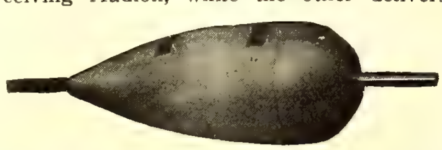
Thus the differences of sensitiveness are less than those found by Wien. The sensitiveness of the ear varies greatly with age, and the upper limit of audition (sometimes stated as 40,000 per second in children) falls steadily with advancing years.

Considering the results in their bearing on radiotelegraphy, it appears that we can, by increasing the spark frequency at the sending station, increase the effective sensitiveness of the receiving station many hundred times. This can be done, too, without entailing the difficulties connected with an increase in the sensitiveness of the wireless receiver itself. An additional advantage in using a high-pitched musical spark is that the ear picks out such signals with ease in the midst of ordinary interferences and strays. In spite of these considerations, however, the practise of some of the wireless telegraph companies and of certain navies is to use notes not higher than 400 or 500 per second frequency. Prolonged trials of high-pitched notes have shown that they tire the ear rather quickly.

AEROPLANES TO CARRY SPECIAL WIRELESS DYNAMO.

The accompanying illustration is that of a new wireless telephone generator for use especially on aircraft.

It is a special generator or dynamo for wireless telephone transmission and reception for use in aeroplanes only. It is a combination of two direct current generators mounted in a torpedo-shaped shell, one of the generators delivering low voltage for lighting the filament of the receiving Audion, while the other delivers 1200 to 1500 volts, direct current, for transmission. Both armatures are mounted on one shaft and supported at both ends by ball bearings. The outfit is intended to be driven by a small auxiliary air propeller. The outfit has been tested and approved by the U. S. Navy.



Special Wireless Telephone Dynamo Recently Developed for Use on Aircraft. It Combines Two Dynamos, One Giving 6 Volts and the Other 1500 Volts, For An Oscillion.

MINNEAPOLIS RADIO TALKS WITH SAYVILLE.

Wireless stations at Sayville, L.I., Darien, Panama, and other distant points on this continent communicated with the All-Crafts Club recently. The event was the annual meeting of the club at the Minneapolis Athletic Club, at which a wireless receiving outfit had been set up.

The club meets every Tuesday noon at the Elks' Club for luncheon, except once during the month, when it meets at the Athletic Club for dinner and a lecture and demonstration of some scientific or mechanical phenomenon. Wireless telegraphy was the subject on this occasion. Mark Frazer and James A. Coles were the demonstrators. Their outfit was capable of picking up European radios had the atmosphere been propitious.

AMERICANS USE WIRELESS FREELY?

Garrulous American sea captains, talking with each other by wireless, have brought down on their heads the wrath of Australian government officials, it was learned recently.

Complaint has reached Washington that American ships 2,000 miles apart in the south seas discuss trivial subjects, when the Australian wireless is trying to get into the air important messages.

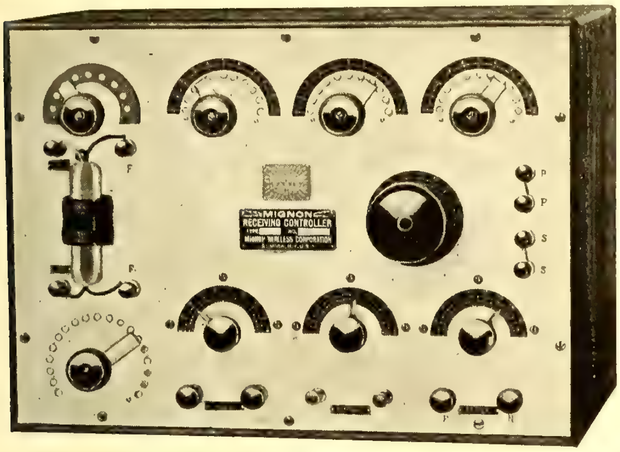
The American captains declare that antiquated wireless equipment in use in Australia is to blame for the situation. They deny that trivial messages have been exchanged.

The Australian charges are being investigated by American government officials and a curb will be put on the practise if it is found that the wireless is being used for a too free exchange of unimportant messages.

New Undamped Wave Tuner Has Adjustable Disc Core

HEREWITH is given a description of a new Undamped Wave Receiver designed by Ernest C. Mignon, the well-known radio engineer.

The object was to eliminate all unnecessary apparatus such as loading-coils and



Appearance of Recently Perfected Undamped Wave Tuner, Which Operates on a New Principle—That Involving a Variation in the Magnetic Coupling, by the Use of a Movable Disc Core.

loose-couplers and above all the *distortion of the magnetic fields* in the tuner by the proximity of the operator's hand or body.

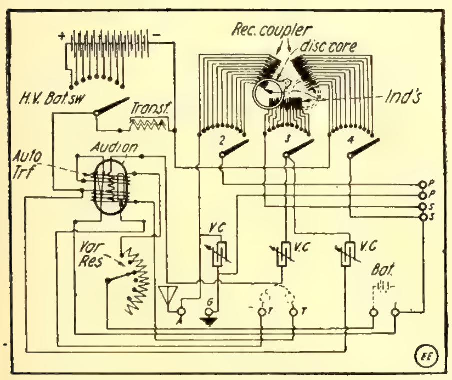
The first step was to build an inductive tuner, consisting of three distinct windings or coils, namely a primary and two inter-circuited secondaries, all three identically the same, ring-shaped and supported in grooves cut into insulate discs, containing the same amount of wire and sections.

These three ring-coils are then solidly mounted on the same plane in clover shape, instead of facing each other, as in all other systems, which is accurately illustrated in the accompanying illustrations.

The magnetic fields of all three coils are interlinked with each other thru the center of each of them and may be pictured as rings or as called hereafter by the inventor, *fields of distortion*, and which for the first time since the history of wireless signaling has been made use of to advantage and proved to be of the greatest importance for future development in radio telegraphy and telephony.

The fields of distortion are identically of the same dimensions as that of the actual coils and facilitate an increase of approximately 100 per cent in the wave length capacity; in other words, it requires only one-half as much wire to build a tuner for a certain wave length of this type, as it would for any other.

One of the features in this invention is



Circuit Connections for Vacuum Detector and Adjustable Disc Core, Undamped Wave Receptor.

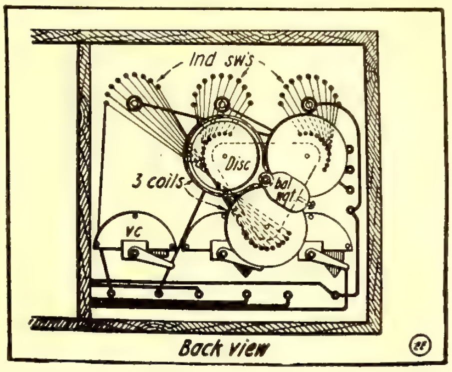
the *Metal Disc* or *Ring Core*, called by its inventor a *Distorter*, which is so installed as to permit all required position adjustments by sliding and rotating the shaft supporting it.

The object of the *metal Distorter* is to control the fields of distortion and to facilitate a decrease or increase in wave length without the cutting in or out of coils or condensers, making it possible to intensify signals to more than 65 per cent of their ordinary strength.

The *Auto-Transformer* encircling the detector bulb has been fully described in a previous issue of THE ELECTRICAL EXPERIMENTER.

One remarkable fact is that only one size of wire is employed in this new system, primary and secondary being the same, and the smaller or finer the more efficient the apparatus, which fact has been positively ascertained by extensive experiments in the laboratory.

Another important feature is that the well-known detrimental effects in other systems due to the close proximity of the different circuit inductances, are entirely eliminated and the capacity of the operator's body has absolutely no effect on the incoming signals, it is claimed.



Rear View of New Undamped Wave Tuner, Showing Position of Three Coils and Movable Disc Core.

On an aerial sixty feet long and thirty feet high, signals from stations 9,000 miles away have been recorded, which were by no means weak.

AN EFFICIENCY SUGGESTION FOR "RADIO-BUGS."

Lately several young men who are studying radio engineering at a nearby university have moved their entire amateur receiving and sending apparatus to the cellar, near the water meter. Their idea is to get the shortest possible ground lead. One youth, whose cellar is too damp to operate in, has his sending set in the cellar but has his receiving set, key, etc., almost directly above on the first floor. The results of these changes were surprising as well as gratifying. One amateur previously having his set in the attic, increased his radiation from 1.7 amps., to 2.2 amps., without touching the closed circuit and by simply putting the open circuit in resonance once more, after the change. These amateurs are considered among the best in this part of the country (Massachusetts) and this little "tip" past to me by one of them, should be helpful to all fellow radio workers.

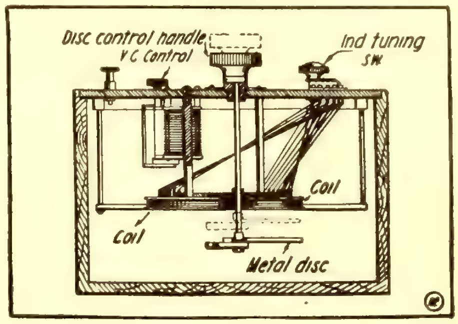
One of these amateurs is 1ZD, who is recognized as the only amateur working any great distance who lives in eastern Massachusetts.

Another is 1ASD, who has heard a number of amateurs in Illinois, Michigan, Indiana, and Ohio; and who has worked 100 miles with a ¼ K.W. transmitter.

Contributed by "BIX."

A SIMPLIFIED CODE.

On page 175 of the July issue of the



Side Sectional View of New Undamped Wave Tuner Having Adjustable Disc Core.

"E.E." an article appeared describing a code composed entirely of *dots*. Such a code is useful to those who wish to tap signals thru a wall, along a pipe, etc., without the use of instruments. When the number of dots constituting a letter is greater than five this code is, however, difficult to send and still more difficult to receive. For those who are already familiar with the Continental or Morse code, a much simpler system is available. This system also saves learning a new code. The only change necessary is to substitute two dots for each dash, i.e.:

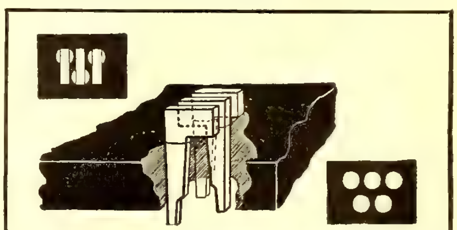
A . ..
B .. . . .
C .. . .. .

This is much easier to read and will be found equally efficient. The idea will prove of advantage to organizations such as the Boy Scouts.

Contributed by F. C. HAMILTON.

A NEW FLAT SWITCH POINT FOR TUNERS.

The new flat switch point here illustrated is a marked improvement in switch points. They are made from flat stock, of brass 1/16" thick and ½ inch long under the head, which makes it possible to get a great many more points in a given space. These points when mounted present a very neat appearance. They are made slightly tapered, which holds them securely in place. It is but necessary to drill the holes in the manner shown in the illustration, that is to stagger them. The switch points are driven in and the connections are soldered



A Flat Point for Multiple Switches Permits Maximum of Contacts in Minimum of Space.

on the reverse side. These switch points, owing to their extremely small bulk, cut down the distributed capacity in an instrument more than half, their inventor claims. This is an extremely valuable feature for serious long distance work.

The Calculation and Measurement of Inductance

By H. WINFIELD SECOR and SAMUEL COHEN

Part I.

This discussion on the calculation and measurement of inductance is intended for the radio experimental and other readers who desire to compute the proper size of tuning coil or loose coupler to use for a certain range of wave lengths. Part 2 of this series will explain in simple language

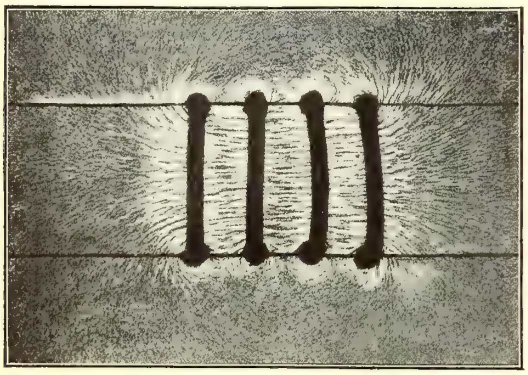


Fig. 1. Appearance of Magnetic Field About a Coil of Wire Carrying Current. "Inductance" Is Exprest as the Opposing Effect of the Self-induced Current, Created by the Magnetic Field Reacting Upon the Coil.

how Inductance is measured, while Part 3, the final paper, will conclude with a practical design of loose coupler, adaptable to various wave length ranges. The day of the 12,000 meter loose coupler is here, and here to stay.

ALTHO a considerable amount of data has been publisht on the subject of *Inductance*, very little has been said regarding its calculation and measurement in a simple enough manner to enable the experimenter to determine the inductance values of coils which he has about his station and laboratory. It is therefore the purpose of this article to show as clearly as possible the method of finding the inductance of a given coil, both of the single and multi-layer types.

Firstly, it is well known that whenever an electric current passes thru a conductor a magnetic field is produced about that conductor, Fig. 1, and the intensity of the field depends upon the current flowing thru the wire. Those magnetic lines of force about the wire produce an e.m.f., passing in the opposite direction to that of the imprest e.m.f.

The effect of this is to counteract the imprest current, thus decreasing its value. This counter e.m.f., acting upon the whole electrical system is called "self inductance" and every conductor irrespective of its shape, length or size, has some self-inductance. However, the amount of inductance of the conductor depends upon several factors, namely: shape, length, diameter of conductor and the amount of current flowing thru the wire. This last term is usually eliminated in actual inductance calculations, especially in coils which are connected in high frequency oscillating circuits.

Since the magnetic effect of a conductor carrying an electric current is increased when the wire is formed into a circle and since the self-inductance depends upon the number of magnetic lines of force produced, it is self-evident that a circular conductor of the same length and same size has a larger self-inductance value than a straight wire. It is readily seen therefore why circular coils are employed instead of long, single conductors. With compact coils the magnetic field is more concentrated.

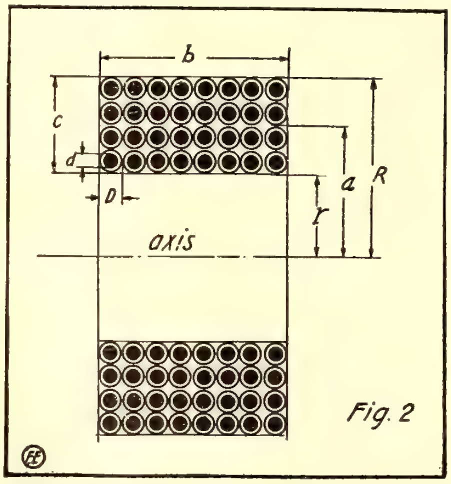
The *Henry* is the unit of inductance. A circuit is said to have an inductance of one henry, when the current is changing at the rate of one ampere per second and inducing a pressure of one volt in the circuit. One henry is equal to 10^9 or 1,000,000,000 (centimeters) C.G.S. electromagnetic units (C.G.S.) is the centimeter-gram-second system; 1 milli-henry = .001 henry or 10^6 centimeters. Henries times 10^9 = inductance in cms., and inductance in cms., divided by 10^9 gives the result in henries. A coil is said to have 1 C.G.S. unit of inductance when 1 C.G.S. unit of current flows thru 1 turn, producing 1 line of force. Let the current in amperes be I, number of turns in coil T, and I_0 number of lines of force due to coil, then we have for the henries of inductance of the coil the expression:—

$$L = \frac{I_0 \times T}{10^8 \times I};$$

The self-inductance of a single, straight round wire can be determined by the formula:—

$$L = 2l\left[2.3026\, log_{10} \frac{4l}{d} - 1\right] \qquad (1)$$

where L = inductance in centimeters.
l = length of wire in centimeters.



Showing Geometrical Dimensions of Coil as Used in Calculating Its Inductance by the Brooks-Turner Formula.

d = diameter of wire in centimeters.

Suppose it is required to find the inductance of a single antenna wire whose length is 400 feet and diameter .08 inch. Converting the above units into centimeters and substituting in formula No. 1, we get:—

$$L = 2 \times (400 \times 30.48)\left[2.3026\, log_{10} \frac{4(400 \times 30.48)}{.08 \times 2.54} - 1\right]$$
$$= 24384\,[2.3026 \times 5.38021 - 1]$$
$$= 27{,}766\ cm.\ or\ .000027766\ henry.$$

It is therefore possible with the above formula to determine the self-inductance of a single antenna wire. The result obtained with this formula is approximate as it does not take into consideration several factors such as curved or bent portions of the lead-in, etc. The surrounding objects about the wire have an appreciable effect upon the inductance also. However, for approximate results the above equation will be found useful.

The common formula given in text-books for computing the inductance of coils having a length *at least* 20 or more times the diameter is given here:

$$L = \frac{10{,}028 \times R^2 \times T^2}{10^{11} \times l}; \qquad (2)$$

Where L is in henries; R the mean radius of coil in inches; T the total turns in coil; l the axial length of coil in inches. Result in cms.=henries$\times 10^9$. For coils containing iron cores the inductance must be multiplied by the permeability, found in all magnetization tables.

The most common form of inductance that the amateur is familiar with is that of a straight cylinder with a certain number of turns on it. The inductance of such a coil can be found by substituting its various dimensions in the following expression:—

$$L = \frac{(5 \times d \times N)^2}{S + \frac{d}{3}} \qquad (3)$$

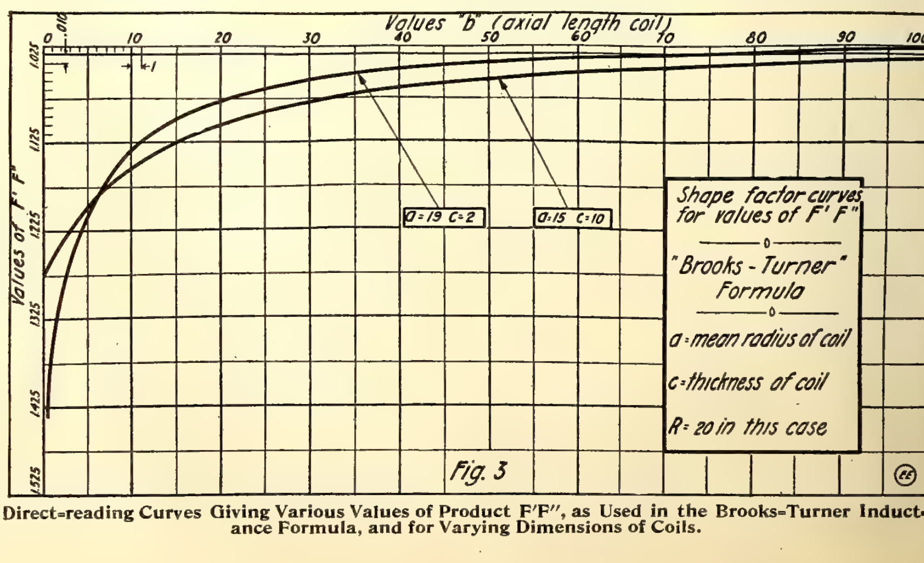
Where: L = inductance in centimeters
d = diameter of coil in inches
N = total number of turns
S = length of coil in inches.

Example:—Suppose it is necessary to find the inductance of a coil whose dimensions are as follows: 12 inches long, 3 inches in diameter with 250 turns of No. 18 wire.

Substituting the given values in the above equation we get

$$L = \frac{(5 \times 5 \times 250)^2}{12 + \frac{3}{3}} = 3{,}004{,}807\ cms.$$

The above coil has an inductance of 3,004,807 cms. and if the result is desired in microhenrys it is only necessary to divide



Direct-reading Curves Giving Various Values of Product F'F", as Used in the Brooks-Turner Inductance Formula, and for Varying Dimensions of Coils.

the answer by 1,000, thus giving 3,004 microhenrys.

The above formula will hold true when the coil is very long (length 20 times diameter, etc.) and when the answer is not required to be very accurate. The formula given below will prove more accurate for a coil whose diameter is greater than its length. This equation is by Dr. A. Russell:

$$L=(\pi DN)^2 l\left[1-\frac{4}{3\pi}\frac{D}{L}+\frac{1}{8}\left(\frac{D}{l}\right)^2-\frac{1}{64}\left(\frac{D}{l}\right)^4\right] \quad (4)$$

Where: L = inductance in centimeters
D = diameter of coil in cm.
N = number of turns per cm.
l = the length of coil in cm.

Altho the above formula is quite accurate for calculating the inductance of a coil of any length, there are still two other formulae which are very accurate for any size coil, even those having a length of one-tenth the diameter or a single turn.

The first of these is due to Nagaoka, who has developed a very simple equation as follows:

$$L=4\pi^2 a^2 n^2 bk; \quad (5)$$

Where:—L = inductance of coil in centimeters.
a = radius of coil to center of wire, in centimeters (mean radius)
n = number of turns of wire per cm. length of coil.
b = length of coil in centimeters.
K = a constant.

The only difficulty encountered in the use of this well-known formula is that involved in the constant, K, the value of which must be obtained from a table. The table gives correction factors for different lengths and diameters of solenoids. It does not take into consideration the so-called *current sheet effect*, which is the effect due to the leak between successive turns of wire. (*See end of this article.*)

For accurate calculations the formula is one of the best that one can employ. These tables are quite large and space does not permit us to publish them here. However, those readers interested in this formula and tables can refer to pages 224 and 225 of the *Bulletin of the Bureau of Standards, Vol. 8, No. 1, by Rosa and Grover, 1912.*

A new universal formula for determining the inductance of any coil, absolutely irrespective of its size and shape, has been deduced by Professor Morgan Brooks. The equation which he has developed is applicable to all sizes of solenoids. This formula has been carefully checked for coils whose inductance was measured and also calculated by other standard precision formulae such as that of Stefan and Kirchhoff for coils of but a single turn. It was found that the results obtained differed infinitesimally from those obtained with Nagaoka's formula.

Two forms of the Brooks universal formula are herewith given. One in which the dimensions are in centimeters and another in which the English units are used. Both give results in henries.

$$L=\frac{Cm^2}{b+c+R}\times\frac{F'F''}{10^9}\ \text{(centimeter units)} \quad (6)$$

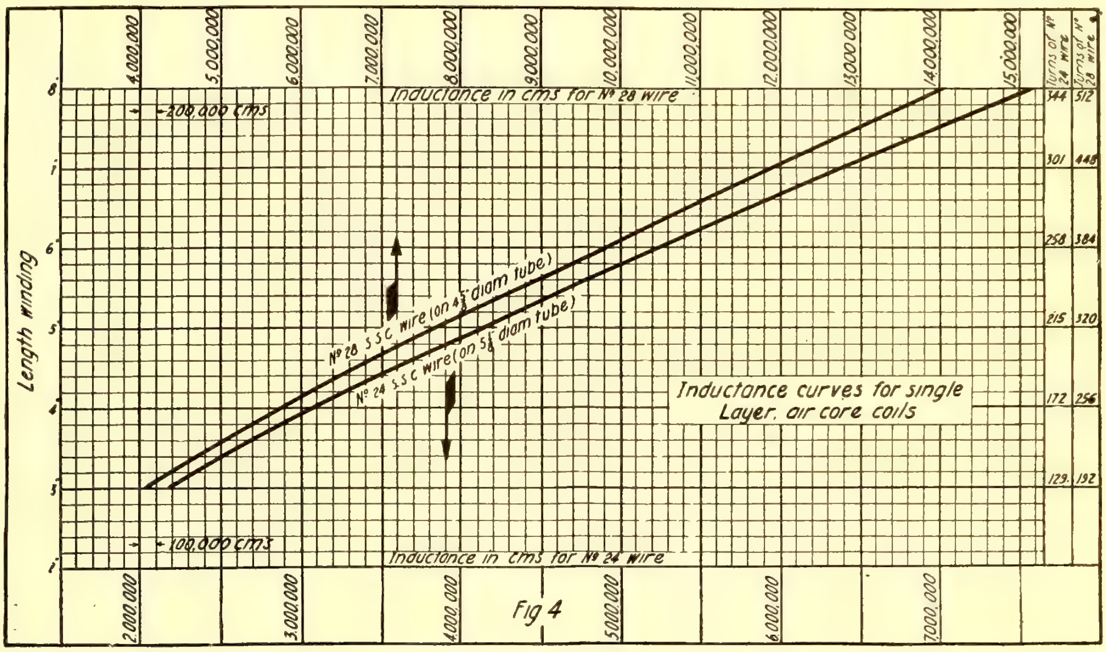
$$L=\frac{0.366\left(\frac{Ft}{1000}\right)^2}{b+c+R}\times F'F''\ \text{(English units)} \quad (7)$$

Where:—L = inductance in henries
a = mean radius of winding
b = the axial length of the coil
c = the thickness of winding; for single turns use (d) dia. of wire in inches
R = the outer radius of the winding
Cm = indicates the length of the conductor in centimeters
Ft = the length of the conductor in feet and $Ft/1000$=thousands of feet

containing any number of layers are covered by it also.

The direct reading inductance curves at Fig. 4 have been calculated by the authors from the Brooks equation (No. 6) and will undoubtedly prove useful to the radio and electrical experimenter as these values have not been given before to our best knowledge. The two windings have been chosen so that one may select suitable length coils for use in building small and medium size loose couplers, tuning coils and variometers.

For the inductance values of larger size coils suitable for extra long wave reception



Direct-reading Curves for the Inductance in Centimeters of Typical Loose-coupler Primary and Secondary Windings.

N = total number of turns in the winding, whence
$Cm = 2\pi aN$ when (a) is in centimeters and
$\frac{Ft}{1000}=\frac{2\pi aN}{12{,}000}$, when (a) is in inches.

In (7) the conductor length is in thousands of feet and the coil dimensions in inches while 0.366 is the conversion factor. F' and F'' are empirical coil-shape factors, dependent upon the relative and independent of the absolute dimensions of the winding. The values for these two factors are obtained by the following expressions:

$$F'=\frac{10b+12c+2R}{10b+10c+1.4R} \quad (8)$$

$$F''=.05\log_{10}\left(100+\frac{14R}{2b+3c}\right) \quad (9)$$

The notation of the different functions used in the first two expressions can be more readily understood by referring to Fig. 2, which is a cross section of a solenoid. The curves of Fig. 3 enable one to select directly the value of the product $F'F''$, for a wide variety of windings, from those having a length about three times the mean diameter to those whose length is but 1/300th the diameter. These shape factors given by Fig. 3 are relative functions only, as becomes apparent and are not in inches or cms., but serve for computations in either system. The Brooks formula is accurate to a small fraction of 1 per cent in most all instances, even for coils of a single turn. In the case of a tested (single turn) coil the calculated value of inductance by this formula was only —0.88 per cent in error, which of course represents the extreme test for any formula of this nature. Solenoids

and the method of figuring the desired amount of tuner inductance, with respect to the electrical constants of the antenna, the reader is referred to the article by Mr. C. Ballantine, entitled *"The Design of Large Radio Receiving Transformers"* in the February issue of THE ELECTRICAL EXPERIMENTER.

In using the Brooks universal formula, the factors, $F'F''$, may be disregarded for long coils and for approximate results the formula reduces to:—(L in henries).

$$L=\frac{Cm^2}{(b+c+R)10^9}; \quad (10)$$

$$\text{Or } L \text{ in cms.}=\frac{Cm^2}{(b+c+R)}; \quad (11)$$

The equation can still be reduced for very long coils, since "b" becomes so large as compared with "c" and "R," so that equation (10) becomes:—(L in henries).

$$L=\frac{Cm^2}{b\times10^9}; \quad (12)$$

$$\text{Or } L \text{ in cms.}=\frac{Cm^2}{b} \quad (13)$$

The above expression will be accurate within the limits of approximation with coils whose length is ten times the diameter. It may be used to advantage in calculating the inductance of spiralled antennae.

In order to become more familiar with the use of Brooks' formula, we will illustrate it with a typical problem. Let us determine the inductance of a variometer coil whose length is one inch, diameter 6 inches and wound with a single layer of No. 20 double cotton covered wire.

$$\left(\frac{Ft}{1000}\right)^2=\left(\frac{2\pi aN}{12{,}000}\right)^2=\left(\frac{2\times3.1416\times3.016\times25}{12{,}000}\right)^2=.001521$$

$$L=\frac{0.366\,(.001521)}{4.064}\times F'F''$$

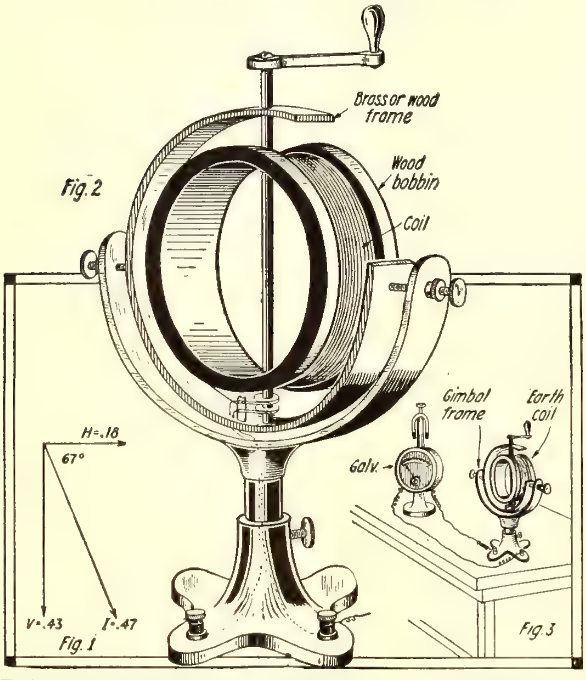
(*Continued on page 850*)

Is Radio Transmission Due to Magnetism?

By J. S. CLEMENS

The writer has lookt up different explanations in several text-books as to the exact theory on which wireless telegraphy is based, but none of them seem to explain the matter very thoroly, and I would therefore like to submit my opinion, which is as follows:

We all know that a compass needle points North and South, demonstrating that there is natural magnetism in the air. To prove that there is magnetism in the air all that is necessary is to take an iron rod, approximately 12" long, 3/8" diameter; wind two layers of No. 20 or No. 22 magnet wire around this rod and connect the two ends of this coil to a galvanometer.



To Demonstrate the Earth's Magnetic Field, Use Is Made of an "Earth" Coil, Shown in the Illustration. This Coil, which May Be Turned or Revolved in Any Plane, Is Connected to a Sensitive Galvanometer. An Experiment That Every Young Electrician Will Find of Extreme Interest.

By holding the coil at one end and waving it to and from the ground, the galvanometer will register a positive electric current in one direction and negative in the other. This goes to show that there are lines of force in the air which reach from the North to the South poles of the earth. By waving the coil you cut these magnetic lines.

All that is necessary to transmit signals is to excite these magnetic lines that are already in the air by a higher voltage. The higher voltage would excite these lines of force and turns them into magnetic waves. These waves can be pickt up at a distance with any wireless receiving outfit. This explanation I believe to be the theory of wireless telegraphy, also wireless telephony.

In wireless telephony the magnetic lines in the air are excited by an arc. To demonstrate this I might state that if you take a magnet and hold it to an electric arc the magnet will blow the arc out; but when the arc is burning in the air the magnetic lines of force in the air are much weaker than if you were holding a magnet to the arc. Realizing that the lines of force are weaker than the arc itself, the arc will have a tendency to create magnetic waves, or in other words vibrate the already existing magnetic lines in the air, when modulated by the human voice.

The magnetic lines of force follow the curvature of the earth, as the earth is a magnet, and consequently wireless telegraph and telephone signals will also follow the curvature of the earth.

Possibly some of the readers of THE ELECTRICAL EXPERIMENTER will give their opinion as to the exact theory on which wireless telegraphy, also wireless telephony.

[Address all communications to the Editor.]

[Editorial Note:—The theory involved in the above discussion by Mr. Clemens is very interesting and possibly brings out some rather startling natural electrical and magnetic phenomena but little known to the average person or even to the electrical experimenter in many instances.

The accepted wireless theories of to-day which, of course, are little more than theories, are based on the supposition that the electromagnetic waves set up by a wireless transmitting station are propagated thru what is known to scientists as the ether. These waves radiate concentrically in a ripple-like formation from the radio sending station in much the same manner as the waves ensuing from a stone dropt in a quiet pool of water; the gradually expanding waves eventually reaching the receiving station or the shore, as the case may be.

However, a very interesting and ever-present natural phenomena is that of the terrestrial magnetism manifested by the earth and which lends itself to a number of interesting experiments, aside from that of the several interesting actions occurring in using the well-known magnetic compass. We know that the magnetized steel needle of the mariner's compass always points toward the north magnetic pole of the earth.

Turning aside from this well-known phenomenon, we come to a very interesting and, albeit, a practical consideration which involves the actual production of an electric current directly from the cutting of the magnetic lines of force emanating from the earth's surface. Insofar as we know, the earth is actually a gigantic natural magnet.

The earth has a magnetic field, the intensity and direction of which are different in different places. In England the field is northerly and inclined to the horizontal at an angle of about 67 degrees. An ordinary compass, by the direction in which it points, shows that this field is northerly; it fails to show that the field is not horizontal because it is so mounted that it can only swing round in a horizontal plane. If it were free to tilt it would point with its north pole downwards at about 67 degrees.

Consider now a North pole of unit strength. In England this will be pulled northerly and downwards by a force of about half a dyne. Resolve this force into two components (Fig. 1); the one, (V), vertically downwards, the other, (H), horizontal and North. The latter is called the horizontal component of the earth's magnetic field; it is usually denoted by the Symbol H; its value in London is about .186 dyne. It is this horizontal component that regulates the behavior of a compass needle: the vertical component has no effect upon it.

Most college laboratories and high schools are equipt with what is known as an earth coil or earth inductor (Fig. 2). These are generally mounted pivotally on a suitable frame or base so that they can be turned slowly or at fairly high speed, the coil being mounted as shown in the illustration.

If we assume that the coil consists of N turns of wire of radius A cms., and that the total resistance of the inductor, and sensitive galvanometer connected with it, is R ohms, then when the coil is placed at right angles to the earth's field, the horizontal component of which is H= (.18 dyne) the number of lines of force passing thru the inductor will be: H N pi A^2, in which pi = 3.1416.

If we turn this coil thru 90 degrees, in order that it shall face East and West, no magnetic lines of force will pass thru it. Hence, the electric charge driven around the circuit will be:

$$\frac{pi\,A^2 NH}{10^8 R}.$$

If we turn the coil thru 180 degrees, the electric charge would have been double this; but if thru an arc of 360 degrees then it would have been zero, as the current would have reverst during the second half of the revolution.

If such an earth coil is constructed having an area of 50 sq. cms., and 40 turns of wire, then when it lies flat upon a table the flux passing thru it will be equivalent to 860 maxwells. If now we connect the terminals of this coil to a sensitive galvanometer and if the total resistance of the complete circuit is 5 ohms, then the electrical energy induced in this circuit by the magnetic earth flux passing thru the coil axially when it is reverst in position will be 3.4×10^{-6} coulombs.

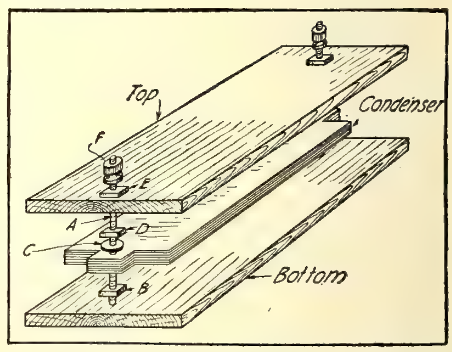
A piece of iron placed in the neighborhood of a magnet becomes itself a magnet. Now the earth is magnetized and therefore all pieces of iron may be expected to show signs of induced magnetism. To illustrate this perform the following experiment. Take an unmagnetized rod of soft iron. Hold it horizontal in the plane of the meridian and tap it gently with a hammer. Now test both ends by means of a compass needle. You will find that the end which pointed north repels the north end of a compass needle. The rod has therefore been magnetised by induction from the earth. To demagnetise the rod, hold it horizontal pointing east and west and strike it a few times with a hammer. After it is demagnetised, hold it vertical and tap it again with a hammer. It will become magnetised again and the North Pole will be at the lower end. If you care to take the trouble you will also find that practically any vertical piece of iron—a pillar, rail or gas pipe—is magnetised with a North pole at the bottom.

CONDENSER AND SWITCH HINTS.

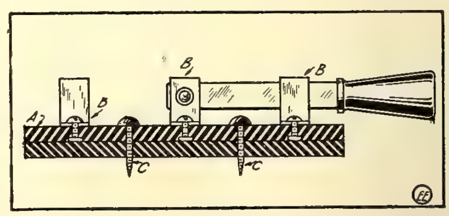
Thick slate for the base of a home-made lightning switch is very hard to obtain, but two thin pieces, A, may be used as shown in the cross-section view. The two pieces may be cut from an ordinary school slate. The holes at B B B, for the switch posts, are drilled thru the top piece only, and the holes, C C, for the wood screws are drilled thru both.

A good way to mount a small receiving condenser is shown below. The top and bottom pieces are of thin, polished wood 1/4" larger than the condenser all around. They each have a hole bored at the ends and holes are punched in the condenser lugs to correspond. Two brass bolts, AA, from dry batteries (the lengths of the bolts are greatly exaggerated in drawing) are thrust up thru the holes in the bottom and the nuts, BB, are screwed on. The condenser is now slipt on and the washers, CC, and the nuts, DD, are screwed tight against the lugs so as to make good contact. Put the top on and tighten up the nuts, EE, turn down the nuts, FF, and your condenser is complete.

Contributed by ROGER HACKNEY.



A Good Way in which to Assemble and Clamp Condenser Leaves.



Making a Suitable Lightning Switch Base from Two Thin Pieces of Slate.

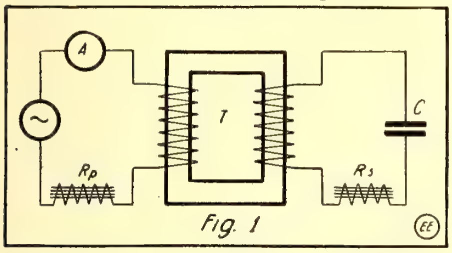
WELLFLEET RADIO OUT OF COMMISSION.

The high-powered radio station here of the Marconi Wireless Telegraph Company of America was out of commission recently as a result of a severe storm. High winds wrecked the antennae of the plant and a number of wires of the Western Union Telegraph Company.

The Quenched Spark Gap

By CHAS. S. BALLANTINE, Radio Research Engineer

DURING the past five years the quenched gap has practically been adopted for commercial work by the various radio companies and seems to be giving complete satisfaction, both in regard to operating efficiency and the reduction of decrement of the radiated oscillations. A device such as this, which has past the test of actual operating conditions of all kinds, must certainly have sufficient merit to warrant its universal adoption.

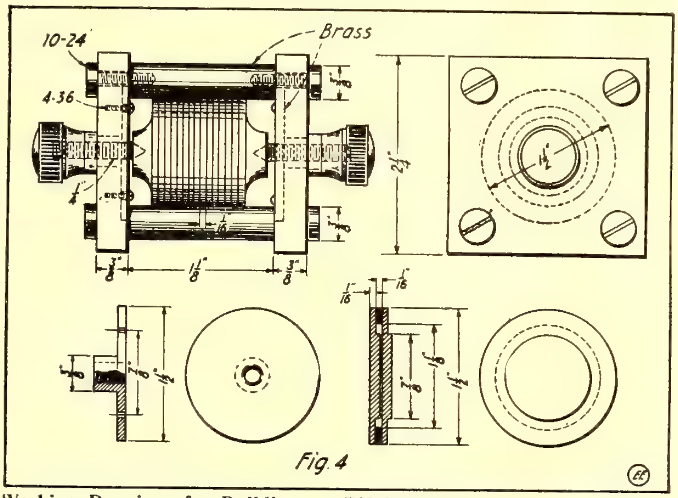


Arrangement of Apparatus for Determining Operating Characteristic of Resonance Transformer.

In amateur circles very few of these gaps are seen, principally because of the cost of their construction and on account of the fact that the few who have tried them have not made a sufficient study of their operating characteristics to attain the results that should be obtained, and hence have condemned them from the start. The expression of such an opinion, founded on nothing more than a cursory examination of their merits, of course is only a display of ignorance which is shown now and then by a few experimenters, but its effect has been quite extensive. The author knows several people who have never used a gap of this sort, and in fact have never seen one, but who from the start have exprest their opinion of it very forcibly. It is with the intention of helping to correct a few of these fallacies regarding the quenched gap that the following paragraphs have been attempted.

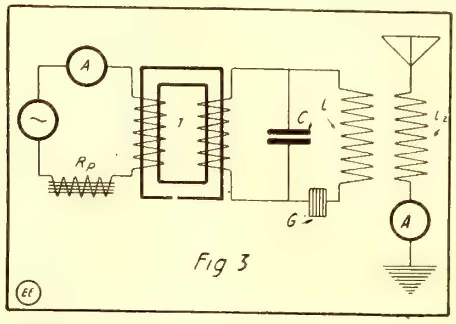
The quenched gap, as most of us know, consists of a number of very short gaps connected in series and made *air-tight.* During the period of the first few sparks across the gap, the oxygen of the air included in the gap *is burnt up.* What probably takes place is as follows: The atmosphere, composed of about 80 per cent nitrogen, 19 per cent oxygen and 1 per cent argon and other inert gases of this group, in the gap is decomposed by the spark into nitric acid from the nitrogen and water vapor, which unites with the metal of the gap to form *nitric oxid gas.* Under certain conditions other chemical reactions may take place, but the final result in any case is the reduction of pressure in the gap and the absence of oxygen in the succeeding discharges. Owing to the fact that all metals contain a certain amount of occluded gas, it is necessary to *season* the gap, by allowing it to operate continuously for a few hours before the note or tone finally becomes clear. If the gap leaks and air is constantly being admitted to the sparking chamber, its presence may be determined by the appearance of the sparking surface, which oxidizes rapidly and becomes covered with a black deposit.

If this occurs, the gap should be thoroly cleaned with alcohol and a piece of crocus cloth or very fine sand paper, taking care to remove all fine particles of foreign matter before reassembling. The gaskets should be examined and cleaned and if they appear to be perfect, the gap may be reassembled, using a little more pressure to bind the plates together. If the gap still continues to leak, replace the gaskets and test it again. Further failure would seem to indicate that the gap was mechanically defective.



Working Drawings for Building an Efficient Quenched Spark Gap, as Described by Mr. Ballantine.

In regard to the engineering aspects of quenched gap operation much has been written, and it will be only necessary to review a few of the basic principles here. In the operation of this gap the condenser capacity and phase relations of the various currents in the transformer are of great importance. Generally the amateur must accept his current as he receives it, when the supply is drawn from the city mains. In cases where the generator is located near the apparatus, some control may be had over its operation, and consequently the adjustments for good working conditions are very much simplified. It is regrettable that this condition is an exception rather than the general rule. In the following discussion it will be assumed that the current supply is drawn from the city mains, and that the phase relations of the currents reaching the primary circuit are unknown. The author has used the following method of adjusting the transmitter for some time, with excellent results:

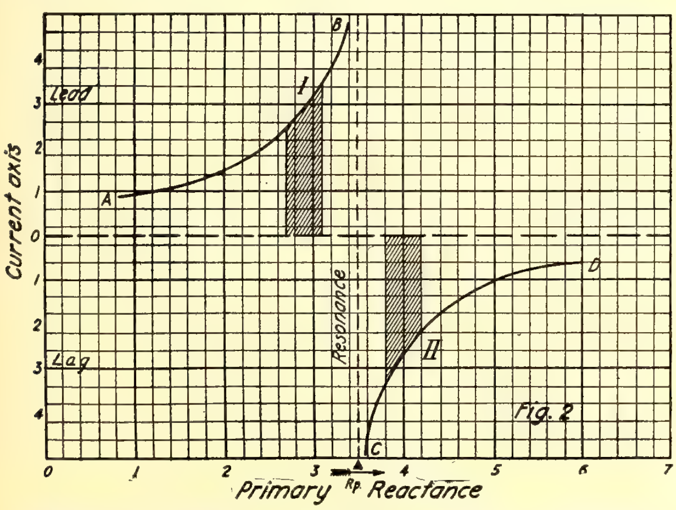


Connections for Quenched Spark Radio Transmitter, as Described in Present Article.

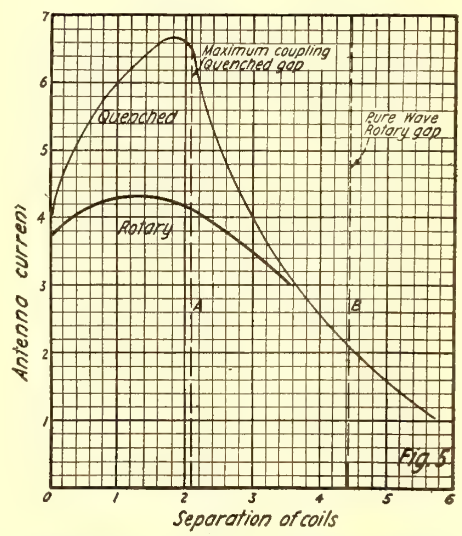
To begin with, it would be well to point out that the method described is one that can be applied to any transmitter, but is particularly useful when the quenched gap is employed, as it is absolutely necessary to have perfect resonance conditions in all circuits with this gap. Otherwise the inferior results referred to in the opening paragraph will probably be obtained.

The apparatus indicated in Fig. 1 are arranged as follows: T represents the low frequency transformer, preferably of the closed core type. An ammeter is connected in the primary circuit as shown at A. The reactance Rp is inserted in the primary. The secondary reactance shown at Rs may be omitted, as its effect on the circuit is slight as compared with that of Rp. This may be seen from the vectors of the ideal transformer. Further, any resistance inserted in the primary side of transformer has an effect equivalent to

(*Continued on page 855*)



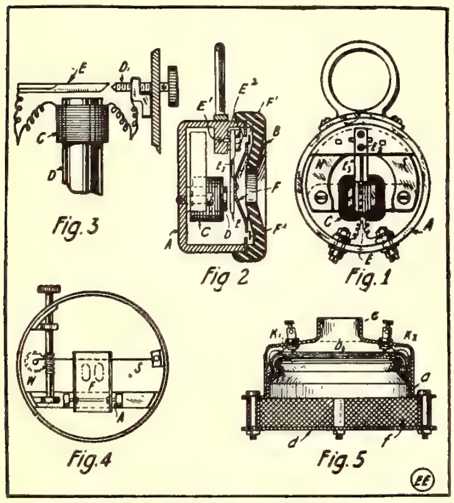
Graphs Showing Off-Resonance Operating Conditions for Well-Tuned Quenched Spark Set.



Graphical Representation of Maximum Coupling Permissible for Typical "Quenched" and "Rotary" Gaps.

Oddities in Telephone and Radio Receivers

THE design of telephone receiver invented by S. G. Brown is shown in plan and section in Figures 1 and 2. Here A is the casing and B the ear-piece, while E is a steel reed, of which one end is fixed to the bridge-piece E^1 on the casing A, by two adjusting screws E^2. N and



Some Novel Designs of Telephone Receivers Intended for Use in Radio Work. They Include a Monotelephone and a Condenser or Electrostatic Receiver.

S represent the north and south poles of the permanent steel magnet, to which are attached L-shaped pieces, of which the vertical parts constitute the cores D, of the coils C, Fig. 2. The ends of these cores slope towards one another under the reed. The portion E^3 of the reed is cut away as shown to increase its flexibility. A suitable free period is from 800 to 1,200 per second. F is a light, conical aluminum diaphragm (not shown in Fig. 1) attached at its center to the reed E, at a point eccentric with respect to the axis of the core D. The periphery of F is close up against the casing, or may be flexibly attached to the casing by a ring of tissue paper, F'.

The extent to which the reed E, can approach the core D, may be regulated as shown in Fig. 3. If the set screw is tipped with gold or platinum, it may be used for short-circuiting the coil when an unduly heavy current reaches the instrument, as indicated in the sketch. High sensitivity is claimed for this receiver.

The One-tone or Monotelephone.

When the diaphragm or reed of a telephone receiver is designed to vibrate at a definite frequency, it is said to be tuned. Such a monotelephone designed by Mercadier consists of a thick diaphragm, resting on three points, actuated by a polarized electro-magnet in the usual way. The instrument shown diagrammatically in Fig. 4 is much more sensitive than Mercadier's. The ferrotype diaphragm is fastened between a tight wire and a fixed axle; the pitch is adjusted by a worm wheel that controls the tension of the wire. The electrical parts (not shown in figure) are the same as in ordinary instruments.

Tuned telephones have not proved very useful in connection with musical spark signals. The note of a spark is very rich in over-tones, and when a receiver is tuned to the spark rate, the energy of the fundamental is collected by the diaphragm, and that of the overtones is thrown away. The addition to a telephone receiver of an acoustic resonator has been tried by many. These resonators usually consist of an air-chamber capable of adjustment to the pitch of the signals, by variations of the internal capacity or of the aperture. They have proved of but little use with spark signals, perhaps for the reason stated in the last paragraph.

Electrostatic or Condenser Telephone Receivers.

The speaking condenser, since its discovery by William Thomson in 1863, has been investigated and developed by a number of individuals. Pollard and Gardner used a polarized condenser as a telephone receiver in 1874, two years before the discovery of the electro-magnetic receiver by Bell and Gray. Dolbear in 1879, however, was the first to obtain good results. Further progress was made by Dr. Cornelius Herz and Dunand in France. With a condenser of 5 M.F. to 10 M.F. capacity, Herz is said to have succeeded in communicating between Paris and Orleans and between Paris and Tours (1881). Since 1881 J. W. Giltay has contributed considerably to the theory of the speaking condenser (1884, 1897). His investigations deal principally with the polarization of the condensers, and he has shown that unpolarized receivers reproduce all sound an octave above the original.

Workers in more recent times include Argyropoulus, H. Abraham (1907) and Peukert (1909). Ort and Rieger have been concerned with the problem since 1907, and reported their first experiments in "E.T.Z", 1909. The use of the apparatus has been chiefly simplified by abandoning a battery for charging in favor of a suitable generator. A brief account of some improvements and experiments in this direction are given below.

The first condensers made by Ort and Rieger, were of rectangular shape with stretched paper dielectric. The edges were clamped to avoid noises due to the condenser itself. Circular leaves were afterwards used, consisting of thin tissue paper, saturated with shellac and coated with tinfoil. The condensers were made up from these leaves to about 0.05-0.06 M.F. and were used, among other things, to prove that the condenser as a whole vibrates as a single diaphragm, and that the amount of sound produced depends upon the area of the plates. These paper condensers were never as sensitive as the electro-magnetic telephone, and the low insulation resistance (about 500,000 ohms), was found to be chiefly responsible.

After much experimenting, india-rubber was selected as the best material for the leaves on account of its high insulating properties and low dielectric losses. Mica, although suitable in other ways, was abandoned on account of these losses. The construction of a rubber sheet, condenser telephone is shown in Fig. 5. On an aluminum drum, a, 10 cm. in diameter, the rubber leaves are stretched in the same manner as a drum skin. They are fixed around the periphery so that no irregular vibration can take place. Each leaf is from 0.3 mm. to 0.5 mm. in thickness and weighs about 400 mg. The drum is covered by a cap, e, provided with contacts, K_1 and K_2, making connection with the plates, while a back plate, d, is fixed at a distance from the case as a reflector for sound from the inner surface of the condenser. The choice of a material for the plates was settled only after many comparative tests, aluminum leaf about 0.001 mm. in thickness being finally adopted as giving the greatest sensitivity. This was attached to the rubber leaves by a special process. The insulation resistance of complete condensers of 0.088 M.F. made in this way was 400 megohms with 110 volts, and 250 megohms with 240 volts.

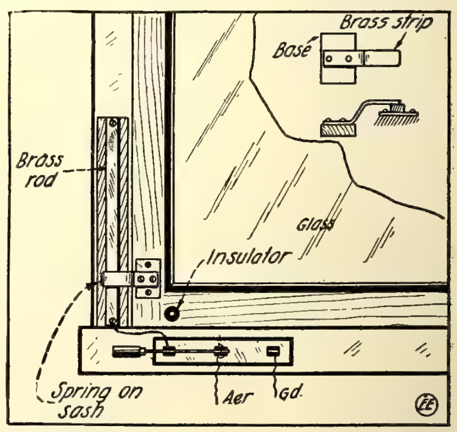
The charging or polarizing voltage is of great importance in relation to the volume of sound given by the receiver. With 240 volts the authors found that the volume was equal to that of an electro-magnetic loud-speaking receiver and increased substantially with voltages of 300 and 400 volts.

The variation of capacity with frequency has also been investigated. The capacity was measured between w—1,800 and 6,000 by the Anderson method, and no variation at all could be detected, whether the charging potential of 240 volts was applied or not. This is in contrast with the electro-magnetic telephone, whose inductance and effective resistance vary considerably, in consequence of the natural vibration of the diaphragm. The condenser telephone has no mechanical natural period. Each of the rubber diaphragms has a period of its own, but the periods of the separate diaphragms are all different, so that no definite natural vibration of the whole system is possible. Moreover, the disposition of the several layers gives such good damping that they vibrate aperiodically. There is no *rattling*, as in the electro-magnetic receiver. Such a receiver has been used in series with radio receiving antennae. These and a number of other interesting devices are described in Dr. Eccle's new work—*Handbook of Wireless Telegraphy and Telephony.*

A WIRELESS LEAD-IN.

To make this wireless lead-in for windows obtain a square metal rod (brass is best) about 3½ feet long. Bore a hole half inch from each end to admit screws. Now screw this rod on to an insulating base as in figure. This should be longer than the metal bar so it may be screwed to the window frame. Then cut a piece of spring brass about 6 inches long and bend and screw to base as shown on sash. Now screw the bar to the stationary outside frame of the window and the spring to the sash as shown in figure. When you open the window, the slider will slide along the bar. Besides doing away with loose wire, it also permits the window to be opened freely.

Contributed by
FRANCIS K. FRASER.



You Can Raise the Window when Fitted With This Clever Lead-In Contact Rail and Shoe, Without Twisting, the Lead-In Rat-tail Cable.

Hongkong, China, has a wireless station with a radius of 500 to 700 miles in daytime and more than 1,300 miles at night.

An electric burglar alarm has been perfected for the chicken coop. Lift the chick and you ring the owner's bell.

A Rotary Receiving Tuner

By Oliver M. Black

The *loose-coupler* I am about to describe is of the variometer type. It is very efficient, having no dead-ends or raps, and it is unusually selective. Moreover, it is so

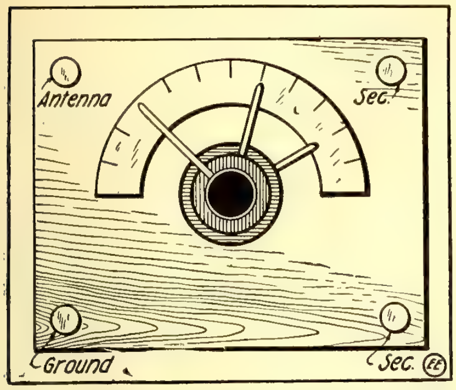


Fig. 1. Front View of Rotary Type, Radio Receiving Tuner. The Relative Position of the Four Windings Can Be Altered Quickly by Means of the Centralized Knob Control.

compact, light and easily portable that it is just the tuner for a portable set. If made from good materials, i. e., mahogany and hard rubber or Bakelite, it adds greatly to the appearance of any station.

The box in which the coils are mounted is preferably of mahogany and measures 10½" high, 12" v ide and 10½" deep. The front panel is of hard rubber or Bakelite.

Fig. 1, shows a front view of the case with the knobs, pointers, 180 degree scale an' binding-posts.

Fig. 2, shows a side view, with the side of the case removed. Coil G, is 9" in diameter and 2¼" wide. It is wound closely for a distance of 2" with No. 24 B. & S. single silk covered magnet wire, starting ⅛" from the edge.

Coil H, is 8½" in diameter and 2¾" wide wound with a few more turns than coil G in order to get the same amount of wire on both coils. *Both coils should be wound in the same direction.* Coil H, is wound with No. 24 B. & S. single silk covered wire. Coil I, is 8" in diameter by 2¼" wide, wound closely for 2" of the width with No. 30 B. & S. single silk covered wire.

Coil J, is 7½" in diameter and 2¾" wide, wound with a few more turns of wire than coil I, in order to get the same amount of wire on both coils. Coil J is wound with No. 30 B. & S. single silk covered wire. Both coils I and J should be wound in the *same direction* as coils G and H.

Coil G is fastened directly to the front

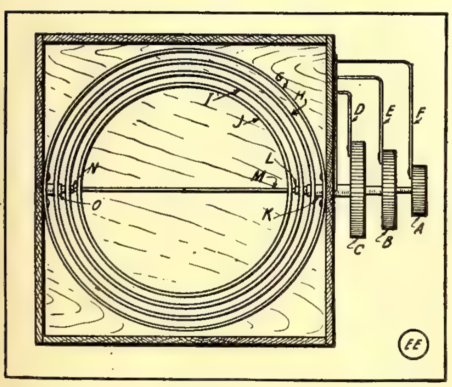


Fig. 2. Side View of Rotary Receiving Tuner of the Modified Variometer Pattern. No Sliders or Switches Are Used.

panel in a vertical position. Coil H is fastened to the brass tube K, on the other end of which is fastened the knob C.

Through the tube K runs another tube L, which will fit snugly and turn rather freely. To the tube L is fastened the coil I. On the outer end of the tube L is fastened the knob B.

Through the tube L runs a rod M, on which is fastened the coil J. On the outer end of this rod M is fastened the knob A. On the back of the case, on the inside, are fastened two tubes N and O of the same size as the tubes L and K respectively, and they act in the same manner as tubes L and K.

To the under sides of the knobs A, B and C are fastened the pointers F, E and D.

The connection of the coils are as follows:—The outside end of coil G goes to the aerial binding-post, while the inside end is fastened to the outside end of Coil H. The inside end of coil H goes to the ground binding-post. (See Fig. 3.)

The utside end of coil I goes to one secondary binding-post while the inside end is fastened to the outside end of coil J; the inside end of coil J goes to the other secondary binding-post.

The connections cribed above should be of flexible, insulated cord with all the joints soldered.

The knobs of A, B and C are preferably of hard rubber. Should the maker wish to mount all instruments in the one cabinet, it is a comparatively simple matter to make the case a little longer, mounting the detector on the outside and the condensers on the inside. Any one carefully following these directions will be able to construct an excellent instrument.

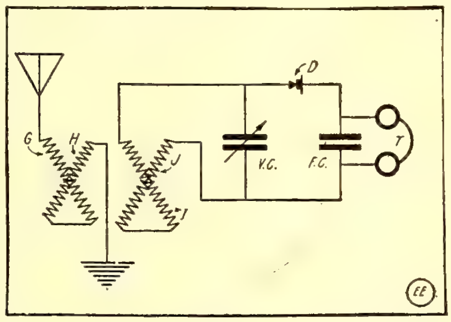


Fig. 3. Hook-Up for Rotary "Switch-less" Tuner.

PSALM XXIII OF THE RADIO BUG.

1. Wireless is my hobby; I shall want no other.
2. It giveth me good grades in Physics; it leadeth me into the fields of invention.
3. It fireth my ambition; it leadeth me in the realms of science for knowledge's sake.
4. Yea, tho I walk thru the valley of the shadow of gloom, I shall fear no bad temper; thy coils and detectors they comfort me.
5. Thou preparest pleasure before me in the presence of disappointments; thou anointest my head with fame, my "pep" runneth over.
6. Surely pleasure and profit shall follow me all the days of my life, and my "call" shall dwell in the ether of the universe forever.

Contributed by JOHN R. MARTIN.

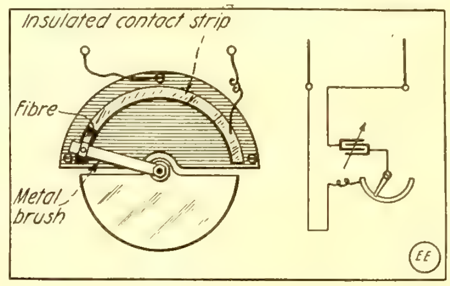
REDUCING ROTARY V.C. CAPACITY TO ZERO.

Those using a rotary variable condenser in shunt to the secondary winding of a loose coupler find that with some stations this decreases the strength of signals. This is due to the fact that there is always some capacity in shunt even though the pointer is set at zero. To overcome this I have designed a switch which does away with the trouble without necessitating the use of an extra switch to cut out the condenser.

By studying the drawing the action will be clearly understood. When the pointer is set at zero on the scale the switch inside of the casing is off the sector, thus breaking the circuit between the movable plates and the secondary winding.

The illustration given shows the inside of the condenser.

The idea might also be used on some of the condensers now supplied the ama-



A Clever Scheme Whereby the Capacity of a Variable Condenser May Be Reduced to Zero, by Opening One Side of the Circuit.

teur market, but to my knowledge there is hardly a rotary variable condenser that possesses an absolute zero.

Contributed by SAMUEL GRISCOM.

A QUICK METHOD OF LAYING OUT ANGLES.

The only things required for the above purpose are a 12" scale and a table of Natural Tangents, such as found in most all engineering hand-books.

Referring to Fig. 1, suppose you want to lay out an angle of 20 degrees and 34 minutes. Consult the table of natural tangents and find corresponding decimal which is .37531; now multiply by A or 5" gives 1.87655 or 1⅞", and draw line C, which completes your angle of 20° 34'.

Since the tangent of angle 20°, 34' is equal to B÷A from trigonometry, therefore to obtain side B it is necessary to multiply the value of the natural tangent or .37531 by 5. Either B or A may be known for producing the angle by substituting the value in the above simple equation.

In fact, the base line A, can be any length, so long as we use the length as our multiplier.

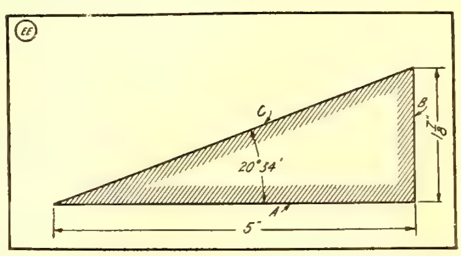
Also such hand-books contain invariably tables of square roots or the square root may be worked out (also by logarithms) applying the usual geometrical law:

$$\text{Length } C = \sqrt{A^2 + B^2}$$

$$\text{Length } B = \sqrt{C^2 - A^2}$$

$$\text{Length } A = \sqrt{C^2 - B^2}$$

It should be noted that all such calculations are to be carried out in units of one denomination, as inches, feet, yards, or



Here Is a Method for Computing Accurately the Height of a Radio Mast or Building, or the Distance Across a Stream.

meters, etc. Never mix up inches with feet.

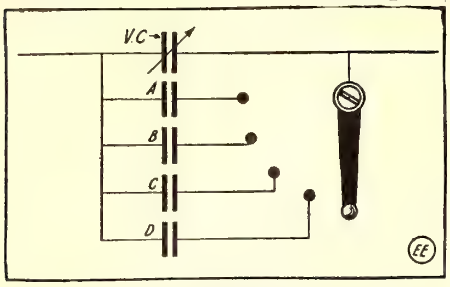
Contributed by JAMES McINTYRE.

When erecting radio masts and spreaders, do not forget that a coat of paint will help to preserve them, including the iron parts.

RADIO CONDENSER HINTS.

When receiving long waves in wireless telegraphy, high capacity variable condensers are often necessary.

As the price increases with the capacity, I devised the scheme here shown diagrammatically.



Clever Scheme for Obtaining Wide Range of Capacities with a Variable Condenser and Several Fixed Units.

V. C. is a variable condenser of about .0005 Mf. capacity. Fixed condensers A, B, C and D are controlled by multi-point switch M. P. S.

In any case the capacities of these are given in table below.

(1)=V. C.
(2)=V. C.+A.
(3)=V. C.+B.
(4)=V. C.+C., etc.

From this it is seen that any capacity from approximate zero to maximum may be obtained. Thus if the V. C. capacity is .0005 Mf. any capacity between approximate zero and .0025 Mf. is obtainable (considering that the unit D has a capacity of .002 Mf.).

Contributed by WALTER D. SHOLL.

SILVER WIRE FOR "CAT-WHISKER" CONTACTS.

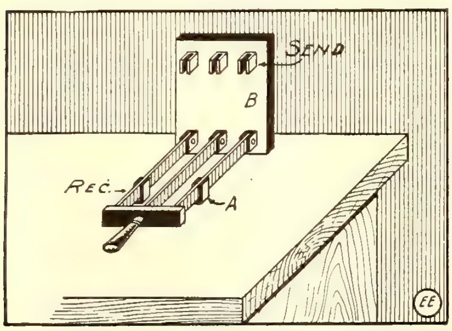
I always used a piece of copper wire for the *cat-whisker* on my galena detector and the signals would die out and I would have to press my buzzer test to bring them in again. I decided to try some sterling silver wire and since then I have never had any more trouble. Silver wire is quite stiff and is hard to shake out of adjustment.

Contributed by
WM. MANSFIELD, JR.

AN INEXPENSIVE AERIAL SWITCH.

A 3 P. S. T. switch and two extra jaws are necessary to construct this switch. The switch and jaws should carry 25 amperes. Second hand ones may be purchased for a small sum at most any electrical shop. Mount the switch, clips up, to your switchboard. See B in illustration. Mount the two extra jaws on a porcelain or a hard rubber base A, and secure to the operating table. Connect as you would any aerial switch. This makes an inexpensive, quick-thrown aerial switch.

Contributed by GEORGE SWEET.



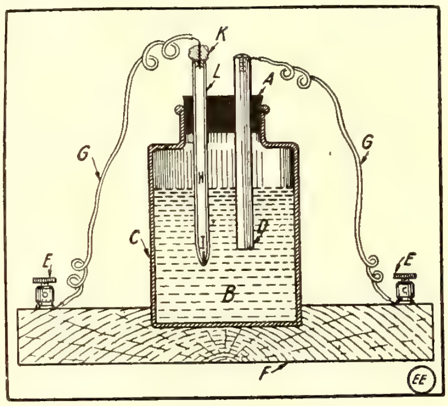
To Make This Aerial Change-over Switch You Will Require a S. T. 3 Pole Knife Switch and Two Extra Switch Jaws.

A BATTERY-LESS ELECTROLYTIC DETECTOR.

As the title implies, this detector does not require a battery for efficient operation. Moreover this detector does not require to be adjusted; that is, it is permanent. For the construction of this detector the following materials will be required:

Article	No.	Dimensions	Remarks
Small wide mouth bottle	1	About 1½ x 2"	
Rubber stopper	1	To fit bottle	Having 2 holes
Zinc rod	1	3 x ⅜"	
Glass tube	1	6" l. x 3-10" I.D.	
Wollaston wire	-	½" long	
Binding post	2		
Wood base	1	4" x 2½" x ⅝	Stain & Polish
5 cents worth mercury.		5 cents worth sulphuric acid.	

Take the glass tube and heat it in a Bunsen burner flame three inches from the end, until it is soft. Care must be taken to revolve the tube during the operation, otherwise it will bend in the middle. When the tube is soft take it out of the flame and pull it out until the heated portion has become quite fine. Then break the tube off about an inch below the point where it begins to decrease in size. Now take the Wollaston wire and remove its silver coating for ¼ in. by immersing it in nitric acid. When this is done insert the wire (thin end out) into the small end of the tube, letting about ⅛ in. protrude. Now carefully revolve the end of the tube in the flame until the wire is sealed in with the end protruding. After it has cooled break the wire flush with the end of the tube and grind the end on a whetstone.



A Battery-less Electrolytic Detector Comprising a "Sealed Point" Electrode and a Zinc Electrode, Both Immersed in an Acid Solution.

Finish the tube by filling it with mercury, closing the end with sealing wax after having placed a wire in contact with the mercury. The zinc rod should be amalgamated. The process is as follows: Put a little mercury in a glass vessel and pour dilute sulphuric acid over it. Clean the rod and dip it into the acid until it touches the mercury. Withdraw the rod and invert it; the mercury should run over the rest of the rod; if it does not, repeat the process. To work the detector fill the glass with sulphuric acid 1 part, water about 8 parts; the exact amount to be determined by experiment. Connect as a crystal detector.

Contributed by L. MOTT-SMITH.

LOW FUSION ALLOY TO MOUNT CRYSTALS.

To make a suitable alloy for the mounting of detector crystals which will melt in hot water melt:

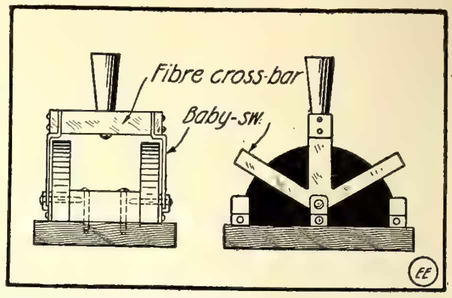
50% Bismuth
25% Lead
12.5% Cadmium
12.5% Tin

over a Bunsen burner, being careful not to use too much heat. After all the ingredients have been melted together and cooled the alloy is ready for use.

Contributed by H. MENDENHALL.

A "BABY" AERIAL SWITCH.

This switch is useful for changing over from "sending" to "receiving" in buzzer or small spark coil radio transmitting sets. It is made of two S. P. D. T. baby switches screwed together on a block of hard rubber or fiber. This block may be screwed to a sub-base. Two holes are bored in each



Using Two "Baby" Knife Switches of the S. P. D. T. Type to Construct a Small Antenna Switch.

of the handles and the cross-bar of fiber screwed on as illustrated. A standard hard rubber pillar is used for a handle.

Contributed by
FRANCIS R. PRAY.

LISTENING TO YOUR OWN SIGNALS WHILE SENDING.

Amateurs often wish to hear how their own signals sound but have no means of doing so, unless they go to some one's station and have a friend operate their set while they listen in.

But this can be done by means of a telephone. Have your friend who has a radio set and telephone call you up while you are sending and have him hold his radio receiver on the mouthpiece of the telephone. In this way you can hear your signals.

Of course a certain time would have to be arranged between yourself and your friend to do this, but you could tell him by wireless that you wanted to hear your signals and he would call up on the phone or vice versa, if he wanted to hear himself send.

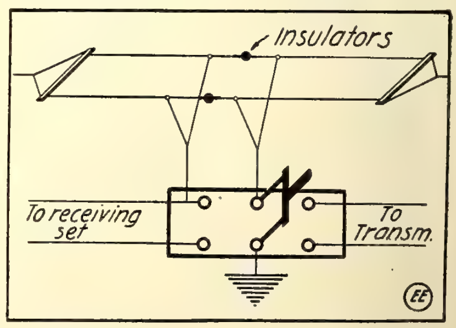
Signals would have to be fairly loud so as to transmit over the telephone.

By this scheme one can adjust his transmitting set and also the sound of the spark very easily.

Contributed by ARTHUR C. YOUNG.

DOUBLE-WAVE AERIAL SWITCH.

The illustration is practically self-explanatory. This hook-up does away with the amateur's problem of how to use a small and large aerial. When the aerial switch is thrown to the left for "receiving," both sections of the aerial are used, (T fashion); when thrown to the right for "sending," the right-hand portion only of the antenna is used. This latter portion need not be half of the aerial, but under the Radio Law should be sufficient to emit a 200-meter wave. The switch should have



How to Connect a D. P. D. T. Knife Switch so as to Use a Short Wave for Transmitting and a Long Natural Wave for Receiving.

well spaced parts, thus adapting it to handle high potentials.

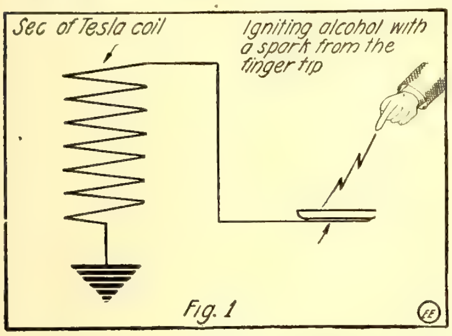
Contributed by AN EXPERIMENTER.

THE CONSTRUCTOR

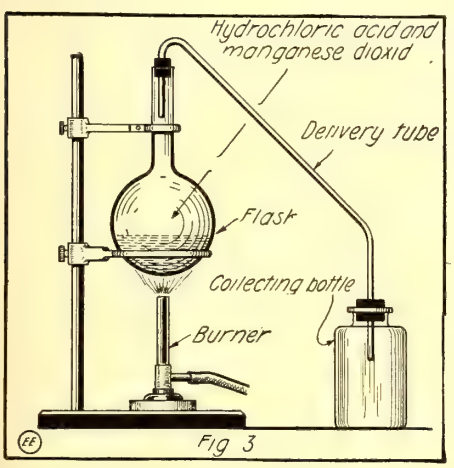
Staging a Scientific Entertainment

By RAYMOND FRANCIS YATES

NOW that the winter months are here, indoor pleasures and entertainments are being thought of more by wireless and electrical clubs, societies and other organizations, and those who wish to stage an entertainment often find it difficult to obtain something new and original that will offer a good evening's amusement for an audience. There will be found in this article an outline for a scientific entertainment which was recently staged by the author with reassuring success, because it contained something unique and spectacular in the way of scientific exhibitions and which did not demand a technically trained audience to appreciate their truly modern magic. It is a deviation from the path of common amateur drama or comedy, and an exhibition that people of ordinary intelligence can thoroly enjoy. This entertainment should appeal especially to wireless and scientific societies who wish to raise funds in order to improve their financial situation. The description of the experiments employed and the method of presentation follows.



Igniting a Pan of Alcohol by Allowing a High Frequency Spark to Jump to it From the Finger.



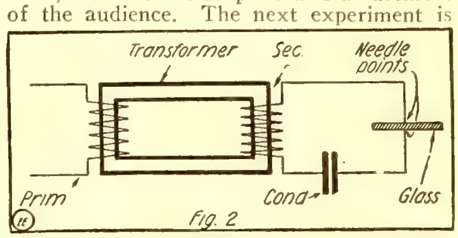
Preparing Chlorin Gas by Chemical Reaction of Hydrochloric Acid and Manganese Dioxid.

A chief demonstrator and two assistants are all the persons required upon the stage. When the curtain rises the chief demonstrator should make an announcement similar to the following: *"Ladies and Gentlemen, we are prepared this evening to offer you a few interesting experiments in science, which you can readily appreciate and enjoy without any technical understanding. Many of the experiments to be shown illustrate well-known chemical, physical and electrical laws which play a large part in our every-day life, and which, but for exhibitions of this kind, many of you would be undoubtedly totally ignorant of. A little knowledge of some of the wonderful natural laws that play such a momentous part in our every-day existence makes life seem more interesting, and we sincerely hope that when you leave here this evening you will carry with you a confirmed belief that the domain of science is not merely an uninteresting and unproductive study, but a gigantic and necessary asset to all mankind. The first experiments will be with 200,000 volts of electricity."*

(Lights turned out and music starts.)

The reference made to experimenting with 200,000 volts as the first demonstration involves the use of a Tesla transformer capable of giving a discharge about 10 inches long. A ½ K. W. step-up transformer in connection with a condenser, gap and small Tesla coil tuned to proper resonance should suffice for this demonstration, and, with the lights out and the music playing, a very impressive exhibition can be made by lighting bulbs, drawing long sparks to the body, exciting Geissler tubes wirelessly, etc. For best results one terminal of the Tesla coil should be grounded. The audience is first shown the crashing 10 inch spark by the performer bringing a metallic object near one terminal of the coil. Next, an ordinary 8 c.p. lamp bulb is grasped firmly in the hand and brought into proximity with the coil. The filament lights up and a peculiar blue discharge takes place within the bulb. By previous experimenting many interesting demonstrations can be devised with an electric light bulb and the author will not enter into detail here in describing them. To show the heat of the spark used an alcohol lamp is lighted by the arrangement shown in Fig. 1. Gunpowder can be exploded in the same manner. By placing in the center of the secondary of the Tesla transformer two pieces of cloth, one saturated with ammonia and the other with hydrochloric acid, a large volume of mist will immediately arise, and by switching on the current the cloud will almost immediately condense.

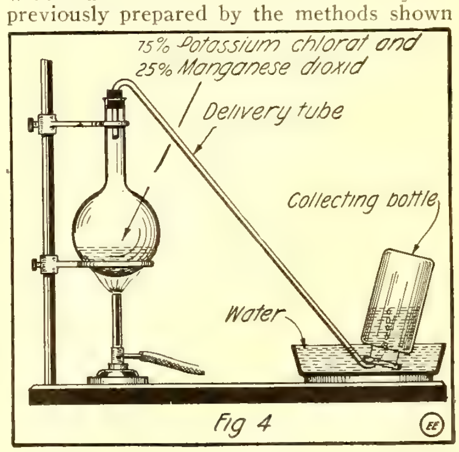
The music is signaled to stop and the performer steps forth and announces that in the next experiment he will permit 200,000 volts to pass thru his body! The voltage is said to be 100 times that used in electrocuting criminals at Sing Sing (or mention your State prison) Prison. To impress the audience with the volume of the current used, and to show what utter disregard it has for insulators, previous to taking the current thru the body, a glass plate is ruptured by it, using the arrangement shown in Fig. 2. It will be noticed that the Tesla coil is left out. After this demonstration the Tesla coil is switched in again and allowed to spark across a gap 8 inches long. The performer then grasps the terminal and allows the current to pass thru his body, the current being allowed to jump to some metallic object held in the hand, much to the surprise and amusement of the audience. The next experiment is



To Show the Great Power of the Transformer a Sheet of Glass Is Punctured by Connecting it Between the High Voltage Terminals.

called an electric or *wireless kiss*, in which the chief performer grasps one terminal of the gap, and, with a pin between his teeth, permits the spark to jump from this pin to a pin in his assistant's mouth. This exhibition is sure to bring applause and is a very simple one. Many other interesting experiments can be evolved, many of which will be found in high frequency text-books, such as that by Thomas S. Curtis, also that by H. Transtrom.

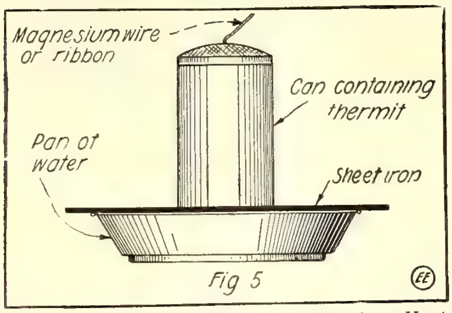
The next demonstrations will be in chemistry, the first being with chlorin. The performer announces how chlorin is being used on the battlefields of Europe and then explains that there are many more humane and useful ways man has found to utilize this foul-smelling and death-dealing gas. The ladies are told that if their colored clothes come back from the laundry bleached snow white, that they can attribute it to chlorin. Two large widemouthed bottles of chlorin may be previously prepared by the methods shown



Apparatus Set Up for the Chemical Preparation of Oxygen.

in Fig. 3. If a piece of cheap colored gingham is first immersed in water and then put into a bottle of chlorin for a moment, it will be bleached almost white. Ink writing on paper can be entirely oblit-

erated by this means, and a green leaf from a plant can be made to lose its color rapidly. If a little powdered arsenic or



Outfit for Demonstrating the Tremendous Heat Produced by "Thermit"—One of the Most Powerful Reactions Known to Modern Science.

antimony is sprinkled into the bottle it will take fire immediately, and if a piece of paper is saturated with warm turpentine it will burn furiously upon being put in the bottle.

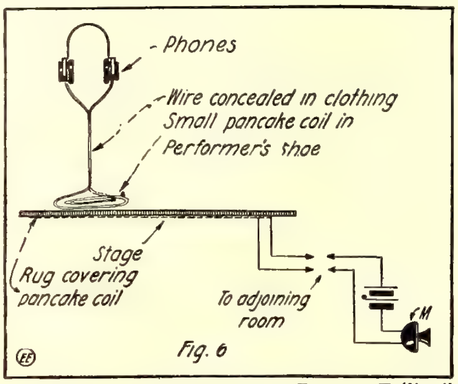
The audience is told that the next experiments will be with *oxygen* and many statements of interest can first be made regarding this gas (see previous numbers of this journal containing "Experimental Chemistry" lessons on Oxygen). A bottle of it is previously prepared as shown in Fig. 4. A small iron wire is heated to redness and then thrust into the bottle of oxygen. It will burn like a match with a great shower of sparks.

Next, the audience is told that common *water* will be changed into *cherry wine.* To prepare this trick, obtain a little lime water and a few tablets of *phenolphathalien* at the drug store. The tablets are put into solution and ten or fifteen drops are placed in the bottom of three table glasses. A water pitcher is filled with water and about a half teacup of lime water is placed in it. When the lime water is poured in the glasses, it will turn to a beautiful crimson color appearing like cherry wine. In a fourth glass, a small amount of concentrated *nitric acid* is placed, and, upon pouring the prepared water into this, it remains white. This is not mentioned, however, and then the audience is told that the wine will be changed back into water. *The glass containing the acid is poured back first,* and when the rest are poured in, they will be changed to white again, due to the action of the acid.

The next experiment will be found to be very interesting and the audience is told that they will now witness the method of blowing safes, as related by Arthur B. Reeve in some of his Craig Kennedy stories. 3,500 degrees of heat are developed in this chemical reaction, which is one of the most powerful known to modern science. The reaction referred to is commonly known as *Thermit,* and in place of preparing it, it is advisable to purchase a one pound can already mixed at a chemical supply house. It is arranged as shown in the drawing, Fig. 5, and ignited by a small piece of magnesium wire. To guard against flying sparks, the performer should wear a pair of goggles during this display. The tin can will be entirely melted, and the charge will also fuse its way thru the sheet iron below and fall with a loud hissing sound into the pan of water beneath.

The next is an amusing experiment and may be easily prepared. A piece of white cardboard is written upon with a solution of cobalt chlorid, which will be invisible. The cardboard is then placed in a picture frame with glass in front of it and a piece of sheet asbestos placed behind it. Be sure that the prepared surface is next to the glass. Now put a few tacks in the back of the frame and string some Nichrome wire upon them. If the wire is connected to the 110-volt circuit it will become heated and the writing in cobalt chlorid will immediately become visible from the effect of the heat.

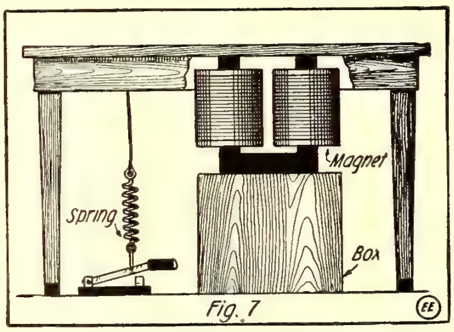
Electrical experiments are again reverted to, the first one being that *telling fortunes via wireless.* The arrangement is shown in Fig. 6, and as will be seen, it is nothing more than an experiment in induction. An assistant is used here, the chief performer requesting that the audience be perfectly quiet so that the *wireless messages* can be properly read. The primary circuit is run to an adjoining room. Small slips of paper are distributed thruout the audience and all are requested to write some word or phrase upon them. The papers are collected by an assistant and taken to the room where the transmitter is installed. They are then read off to the assistant who is sitting in the cen-



A Wireless "Mind-Reading and Fortune-Telling" Outfit That Operates by Induction Between Two Coils Placed on the Stage or Platform.

ter of the stage, blind-folded and wearing a pair of 'phones. This will cause no little wonderment when the people hear their statements being read, and they will really think that it is accomplisht by wireless. In reality it is.

The next experiments are magnetic in na-



The Popular "Fried Egg" Induction Trick is Accomplisht by Holding the Frying Pan Above the Table, Under which a Powerful A. C. Electro-Magnet Is Placed.

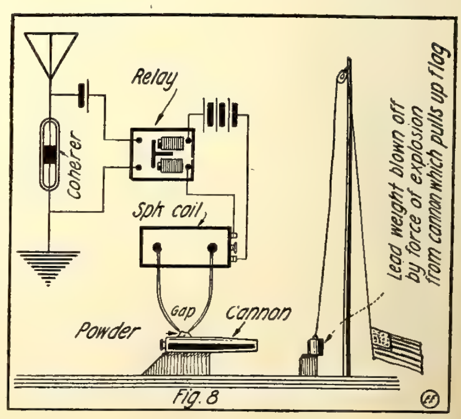
ture and are probably the most interesting and spectacular of the whole entertainment. A core for a ½ K.W. is made or purchased and each leg would with about 250 turns of No. 10 S.C.C. magnet wire. The coil is placed under a thin-topt table as shown. The front of the table is covered to conceal the magnet. The performer takes his place behind the table and taking a small aluminum disk, places it on the table top directly over the poles of the magnet. Using a small wand, he commands the disk to jump into the air, which it does, as the current is sent thru the magnet by tripping the foot-switch. The disk will act as a short-circuited coil, with the same polarity as that of the large magnet, and instead of being attracted, it will be repelled. The audience will be amazed to see this disk thrown into the air without any visible force acting upon it. This can be repeated again and again, and, by careful manipulation, it will appear as if the wand had absolute control over the disk. If a small iron (better copper) frying-pan is placed over this magnet it will become heated and, while not hot enough to properly fry an egg, a little butter placed in with the egg will sputter and make it appear as if the egg were being fried. A loop of aluminum wire will be thrown into the air much higher than the disk. If about three pounds of annunciator wire is wound into a coil and connected to a lamp, the lamp will light when brought into the field of the magnet. This experiment can be made to appear still more mysterious by placing the coil and lamp under water in a large glass jar. If a coil of a few turns of No. 4 magnet wire is made and connected to a fuse wire, enough current will be induced into the coil to *blow* the fuse wire. The audience will be astonished and wonder where the large amount of current is really coming from.

The next demonstration is the concluding one. It is that of controlling apparatus by wireless. A sensitive telegraph relay and coherer will be required, and are connected as shown. The transformer, gap and condenser of the Tesla outfit are used for the transmitter. A small table containing the apparatus to be actuated is placed in the back of the room and the devices are controlled from the stage. The audience is shown that no wires are connected to the table. After lighting lamps, running motors and ringing bells, a small cannon is exploded and at the same instant a battery motor may be thrown into operation, hoisting an American flag and the orchestra starts playing the National Anthem. A method of hoisting the flag and exploding the cannon are shown in Fig. 8. The details of some of the experiments can well be worked out by the ingenious reader, who will gain considerable knowledge thereby. We can all do the simple stunts—but the harder ones call for more concentrated effort and always repay one for the trouble taken to work them out successfully.

CONNECTING EXTENSION BELL TO A TELEPHONE.

Our telephone being located downstairs, it was often impossible to hear it ring when the people were on the upper floors. To overcome this, a bell was connected from the 'phone to the upper stories in this manner: A wire was run from a telephone gong to an ordinary vibrating bell upstairs, with one or two cells for battery, and back again to the clapper so that the clapper striking the gong, to which the wire was connected, would rapidly open and close the circuit and sound the different rings upstairs. A switch was also inserted, in the circuit, but can be dispensed with.

Contributed by A. BELL GREENE.

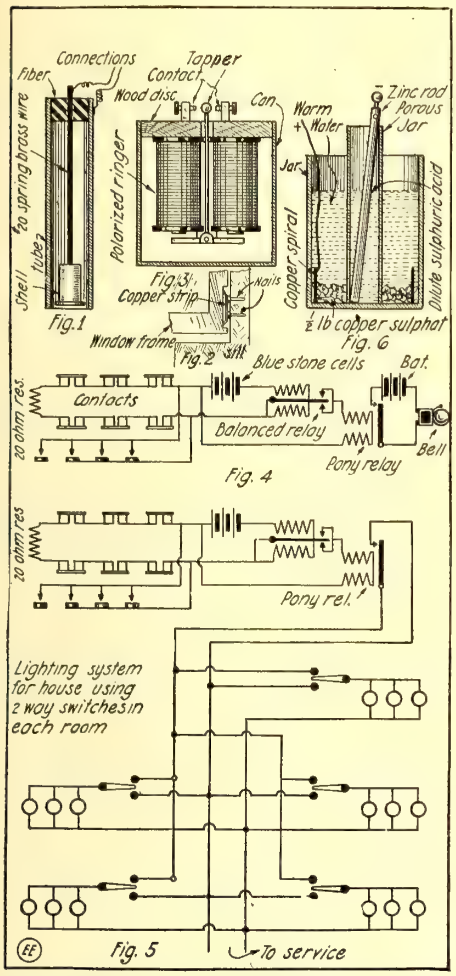


Raising a Miniature Flag by Radio. Spark Coil Fires Cannon Which Blows Weight Off Block, Releasing Flag.

A BALANCED RELAY BURGLAR ALARM SYSTEM.

AN alarm system for burglar protection consists of three main parts in a balanced system. The contacts, the relay and the alarm constitute the main sections and we will deal with them in this order.

The contacts here utilized are of both



Constructional and Wiring Details for a Doubly Sure Burglar Alarm System, Utilizing a Balanced Relay Made from a Polarized Telephone Ringer.

the open and closed-circuit types. The former are made as shown in Fig. 1. A number of brass tubes, ½" inside diameter and 6" long, are first obtained. An insulating block supporting a spring brass wire and contact is mounted in one end of the tube.

The contact may consist of a 38-calibre cartridge shell soldered to the end of the wire. The connections are then soldered to the wire and tube.

These contacts may be put in the most unusual places: the hems of curtains, back corners of drawers and by drilling a hole into the woodwork of the door they can be readily inserted. A door accidentally left ajar is thus protected, since moving it would cause the shell to touch the tube due to inertia, and the alarm would be sounded.

The closed-circuit contacts may conveniently take the form of two nails or screws over which a metal short-circuiting shoe passes. Fig. 2 shows them applied to windows, but shutters and doors may be protected in the same way.

The relay will now receive attention. A very good one can be made from an ordinary polarized telephone bell ringer. Obtain a can 4" in diameter and as deep; cut a lid from ½" wood to fit inside. Mount the ringer inside the can as shown with tapper extending (Fig. 3). By bending the tapper arm *slightly* it will be caused to drop to one side.

Two contacts are mounted on the wood base at either side of the tapper. Adjusting screws are provided as shown. These screws, as well as the tapper arm, should be silver or platinum tipt. This is not to be adjusted until wired into the circuit.

The alarm signal is usually a bell or buzzer, but where the house is wired for electric lights, the scheme of turning on every light on the premises is a very good one in addition to the bell. Therefore two hook-ups are shown, one using the regular bell (Fig. 4); the other (Fig. 5) switching on the lights so that they cannot be turned off in any of the rooms, but only by resetting the alarm circuit-closer.

The circuit is wired with No. 18 cotton covered bell wire and a resistance of 20 ohms is connected in at the far end of the line. The relay is then adjusted so that the tapper arm lies between the two contacts. Should the circuit be closed or in fact tampered with in any way the tapper will fall against one or the other contact and will stay there, due to the special wiring. Thus the alarm will be given even should the circuit return instantly to its original condition.

The closing of the balanced relay operates the second pony relay, switching on the lights or ringing the alarm bell as desired.

The batteries for this system should be copper sulfate cells. They can be easily made by following the sketch, Fig. 6, and should cost less than 50c. a piece; three or four being sufficient. Dry cells can be used for operating the bell.

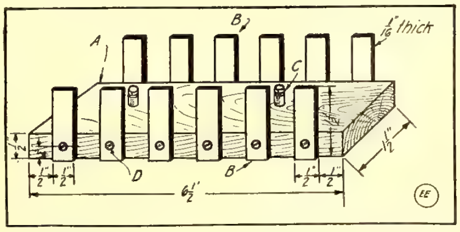
Contributed by
THOMAS W. BENSON.

A PACHYTROP FOR SERIES OR PARALLEL CONNECTION.

A Pachytrop is an apparatus which enables us to connect the cells of a storage or primary battery in series or in parallel by simply manipulating a single handle or by similar means. An instrument of this description is extremely useful when a storage battery is being charged continuously by a gravity or copper-oxid battery. If the storage battery consists of six cells the E.M.F. is about 12 volts; the E.M.F. of the three gravity cells is only 2.7 volts, which means that we will have to connect our storage cells in parallel.

If we should want to use the storage battery with an E.M.F. of 12 volts, e.g., cells in series, it would be necessary to change all connections and after the experiment, when the charging is to begin again, change them back again to parallel. This is where the Pachytrop comes in.

By simply inserting two different connectors we can change the E.M.F. from 2 to 12 volts. The Pachytrop described here consists of a strip of wood, A, which carries six brass strips, B, on each side. The brass strips, B, on one side are connected to the positive electrodes of our storage cells, while the strips on the other



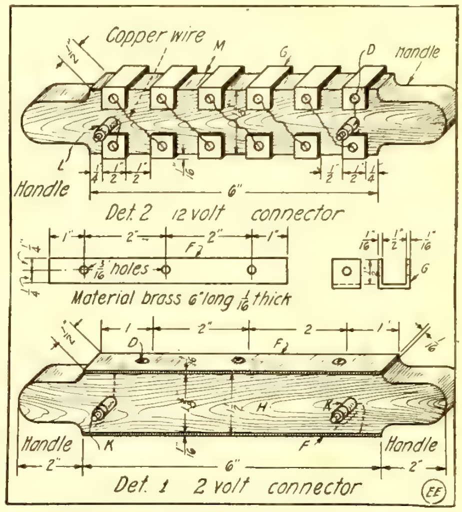
Detail of Pachytrop Stationary Contact Block and Metal Jaws, Between which Rests the Removable Switch Block.

side are connected to the negative electrodes. The connector, 1, which gives 2 volts, e.g., all cells in parallel, consists of a piece of wood, H, on each side of which is a brass strip, F, running the entire length of the parallel part of H. Each brass strip, F, is connected to a binding post, K.

It will be evident that if we insert this connector, 1, between the brass strips, B, then all positive and all negative electrodes will be in parallel. By inserting the connector 2 we get 12 volts; that means all cells in series.

This second connector consists of a similar strip of wood, M, to which small brass clips, G, are screwed; these strips are connected as shown and the two remaining ones connected to two binding posts, L. Its construction will now be described.

First, plane a piece of wood, A, to the dimensions given, 6½" long, 1½" wide and ½" thick. Next procure some brass or copper strips ½" wide by 1/16" thick and cut the strips, B, of which 12 are required. Drill a hole 3/16" dia. thru B,



Different Styles of Switch Blocks for Series-parallel Battery Pachytrop.

at a distance of ¼" from the bottom and fix the strips B as shown to the board A, using wood screws D. The strips are spaced ½" apart and the board A may be screwed to the accumulator box by wood screws C. Bend the tips of the strips slightly outwards as this makes it easier to introduce the connectors.

For the connector 1 take a piece of wood H and plane down to 10" long, 1⅜" wide by ½" thick. Two handles, 2" long should then be cut on this piece while the center part is left parallel. A brass strip ½" wide by 1/16" thick is cut as shown in detail of F and screwed to H.

Connect each strip to a binding post K and connector 1 is completed. Connector 2 is made in a similar manner, using clips G bent from the same strip as used for F and connecting them as shown. The two remaining clips are connected to two binding posts, L.

Contributed by C. A. OLDROYD.

DID YOU SAY SILVER-PLATED WINDINGS? WELL, HERE'S HOW.

Recently I broke the "G" string on my violin. It is a cat-gut string wound with silver-plated copper ribbon about 1/64 inch wide. Upon trial I found this to be very satisfactory, as it shows a very low ohmic resistance.

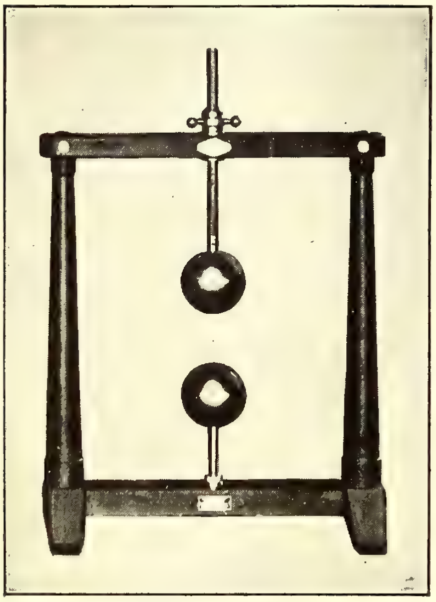
These strings may be secured from any music supply house, one of them advertising a gut string wound with pure silver wire at 35 cents. The silver plated steel "E" strings can be used but the steel makes the resistance rather high. The fact that the radio-currents remain on the outer surface of conductors might render them as efficient as the "G" strings.

Contributed by WM. B. SPURRIER.

Testing High Voltages With Spark Gaps

The A.I.E.E. recommend these rules for testing high voltages with a spark gap.

Measurements with Spark Gaps. If proper precautions are observed, spark gaps may be used to advantage in checking the calibration of voltmeters when set up for the purposes of high-voltage tests of the insulation of machinery.



A Standard 100,000 Volt "Spherometer" for Testing High Potentials by the Spark Gap Method, in Accordance with the A.I.E.E. Rules.

Ranges of Voltages. For the calibrating purposes set forth the sphere gap shall be used for voltages above 50 kv., and is to be preferred down to 30 kv. The needle spark gap may, however, be used for voltages from 10 to 50 kv.

The Needle Spark Gap. The needle spark gap shall consist of new sewing needles, supported axially at the ends of linear conductors which are at least twice the length of the gap. There must be a clear space around the gap for a radius of at least twice the gap length. The sparking distances in air between No. 00 sewing needlepoints for various root-mean-square sinusoidal voltages are as follows:

TABLE 1.

Needle Gap Spark-Over Voltages.

(At 25° C. and 760 mm. barometer).

R. M. S. Kilovolts	Millimeters	R. M. S. Kilovolts	Millimeters
10	11.9	35	51
15	18.4	40	62
20	25.4	45	75
25	33	50	90
30	41		

The above values refer to a relative humidity of 80 per cent. Variations from this humidity may involve appreciable variations in the sparking distance.

The Sphere Spark Gap. The standard sphere spark gap shall consist of two suitably mounted metal spheres. When used as specified below, the accuracy obtainable should be approximately 2 per cent.

No extraneous body, or external part of the circuit, shall be nearer the gap than twice the diameter of the spheres. By the "gap" is meant the shortest path between the two spheres.

The shanks should not be greater in diameter than ⅕ the sphere diameter. Metal collars, etc., through which the shanks extend, should be as small as practicable and should not, during any measurement, come closer to the sphere than the maximum gap length used in that measurement.

The sphere diameter should not vary more than 0.1 per cent and the curvature, measured by a spherometer, should not vary more than 1 per cent from that of a true sphere of the required diameter.

In using the spherometer to measure the curvature, the distance between the points of contact of the spherometer feet should be within the following limits:

TABLE 2.

Spherometer Specifications

Diameter of Sphere in mm.	Distance between contact points in mm.	
	Maximum	Minimum
62.5	35	25
125	45	35
250	65	45
500	100	65

In using Sphere Gaps constructed as above, it is assumed that the apparatus will be set up for use in a space comparatively free from external dielectric fields. Care should be taken that conducting bodies forming part of the circuit, or at circuit potential, are not so located with reference to the gap that their dielectric fields are superposed on the gap; *e.g.*, the protecting resistance should not be arranged so as to present large masses or surfaces near the gap, even at a distance of two sphere diameters.

In case the sphere is grounded, the spark point of the grounded sphere should be approximately five diameters above the floor or ground.

TABLE 3.

Sphere Gap Spark-Over Voltages.

The sparking distances between different spheres for various r.m.s. sinusoidal voltages shall be assumed to be as follows:

(At 25° C. and 760 mm. barometric pressure)

Kilovolts	Sparking Distance in Millimeters.							
	62.5 mm.		125 mm.		250 mm.		500 mm.	
	One sphere grounded	Both spheres insulated	One sphere grounded	Both spheres insulated	One sphere grounded	Both spheres insulated	One sphere grounded	Both spheres insulated
10	4.2	4.2	.....	.....	.....	.....	.....	.....
20	8.6	8.6	.....	.....	.....	.....	.....	.....
30	14.1	14.1	14.1	14.1	.....	.....	.....	.....
40	19.2	19.2	19.1	19.1	.....	.....	.....	.....
50	25.5	25.0	24.4	24.4	.....	.....	.....	.....
60	34.5	32.0	30.	30.	29	29	.....	.....
70	46.0	39.5	36	36	35	35	.....	.....
80	62.0	49.0	42	42	41	41	41	41
90		60.5	49	49	46	45	46	45
100			56	55	52	51	52	51
120			79.7	71	64	63	63	62
140			108	88	78	77	74	73
160			150	110	92	90	85	83
180				138	109	106	97	95
200					128	123	108	106
220					150	141	120	117
240					177	160	133	130
260					210	180	148	144
280					250	203	163	158
300						231	177	171
320						265	194	187
340							214	204
360							234	221
380							255	239
400							276	257

The sphere gap is more sensitive than the needle gap to momentary rises of voltage and the voltage required to spark over the gap should be obtained by slowly closing the gap under constant voltage, or by slowly raising the voltage with a fixed setting of the gap. Open arcs should not be permitted in proximity to the gap during its operation, as they may affect its calibration.

When the variation from sea level is not great, the relative air density may be used as the correction factor; when the variation is great, or greater accuracy is desired, the correction factor corresponding to the rela-

(*Continued on page 858*)

FIXING PRINTS.

Ammonia forms one of the best fixing agents for prints and is to a certain extent superior to hyposulfite of soda used for this purpose. It gives clear whites and dissolves very little of the silver.

The solution consists of 1 part of ammonia to 5 parts of water. The length of fixing should not be more than 15 minutes. Another advantage is that the prints do not require much washing after fixing.

Contributed by THOS. W. BENSON.

COMBINATION ELECTRIC LOCK.

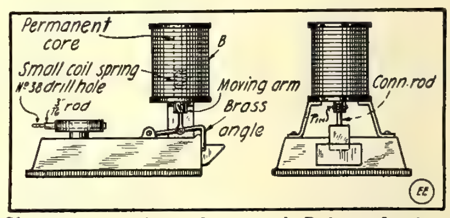
In my home I have a workshop which I call my "laboratory" and I have a Yale lock on the door. I had a lot of trouble keeping my younger brother out when I was out of town, as he found my key and made one for himself. I came home often and found things missing or disturbed, so I found it necessary to put on some other kind of lock which would keep him guessing for a while.

I made a solenoid coil A, 3 inches long, with a ¾-inch core of thin brass tubing, and wound it with twenty-four layers of No. 18 enamel wire and also one with a 5/16 inch hole wound with No. 22 wire (B in Fig.). This one was 1½ inches long and 1⅛ inches in diameter.

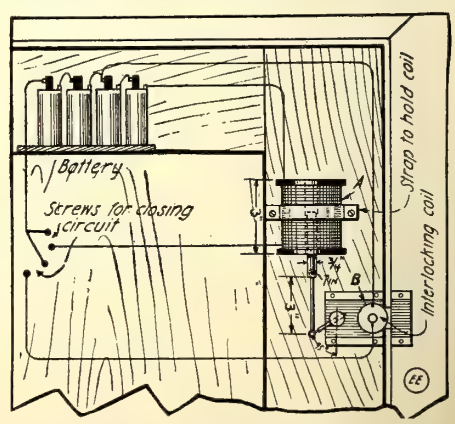
Boring a 3/16 inch hole in the handle of the lock at an angle of 45 degrees from the bottom, I placed a 3/16 inch rod in it and let it extend out 1 inch towards the back, so that when the rod is lifted the latch or ocking bar is drawn in. There is drilled a No. 38 hole in the extending end of this rod and the sides are flattened by filing.

I then mounted the large solenoid coil on suitable brackets on the door with its armature only in the coil one-half inch. I eft room for a 3 inch connecting rod between armature and rod in the knob. I used 5 dry cells and 2 brass screws in the door on the outside, so that by short-circuiting the screws the magnet lifted the rod and unlocked the door.

This you will notice does not keep my brother or others from entering if they have the key, and as I did not want to remove the key barrel from the lock, in case



Side and End Views of Magnetic Release for Auxiliary Locking Arm Fitted to a "Yale" Lock.



How a Solenoid Magnet Is Employed to Turn the Latch Spindle when the Circuit Is Closed at a Secret Contact.

he electric opener should not work, I used the small brass angle, a detail of this idea appearing in the figure.

Contributed by ALLEN DALE.

Standardization Rules, American Institute of Electrical Engineers. Definitions (Revised)

The following definitions are intended to be practically descriptive, rather than scientifically rigid.

CURRENT, E.M.F. and POWER.

(The definitions of currents given below apply also, in most cases, to electromotive force, potential difference, magnetic flux, etc.)

Direct Current. A unidirectional current. As ordinarily used, the term designates a practically non-pulsating current.

Pulsating Current. A current which pulsates regularly in magnitude. As ordinarily employed, the term refers to unidirectional current.

Continuous Current. A practically non-pulsating direct current.

Alternating Current. A current which alternates regularly in direction. Unless distinctly otherwise specified, the term "alternating current" refers to a periodic current with successive half waves of the same shape and area.

Oscillating Current. A periodic current whose frequency is determined by the constants of the circuit or circuits.

Cycle. One complete set of positive and negative values of an alternating current.

Electrical Degree. The 360th part of a cycle.

Period. The time required for the current to pass through one cycle.

Frequency. The number of cycles or periods per second. The product of 2π by the frequency is called the *angular velocity* of the current.

Root-Mean-Square or *Effective Value.* The square root of the mean of the squares of the instantaneous values for one complete cycle. It is usually abbreviated r.m.s. Unless otherwise specified, the numerical value of an alternating current refers to its r.m.s. value. The r.m.s. value of a sinusoidal wave is equal to its maximum, or crest value, divided by $\sqrt{2}$. The word "virtual" is sometimes used in place of r.m.s., particularly in Great Britain.

Wave-Form or *Wave-Shape.* The shape of the curve obtained when the instantaneous values of an alternating current are plotted against time in rectangular co-ordinates. The distance along the time axis corresponding to one complete cycle of values is taken as 2π radians, or 360 degrees. Two alternating quantities are said to have the same wave-form when their ordinates of corresponding phase (see Phase) bear a constant ratio to each other. The wave-shape, as thus understood, is therefore independent of the frequency of the current and of the scale to which the curve is represented.

Simple Alternating or *Sinusoidal Current.* One whose wave-shape is sinusoidal.

Alternating-current calculations are commonly based upon the assumption of sinusoidal currents and voltages.

Phase. The distance, usually in angular measure, of the base of any ordinate of an alternating wave from any chosen point on the time axis, is called the phase of this ordinate with respect to this point. In the case of a sinusoidal alternating quantity, the phase at any instant may be represented by the corresponding position of a line or *vector* revolving about a point with such an angular velocity ($\omega = \pi 2 f$), that its projection at each instant upon a convenient reference line is proportional to the value of the quantity at that instant.

Non Sinusoidal Quantities. Quantities that cannot be represented by vectors of constant length in a plane. The following definitions of phase, active component, reactive component, etc., are not in general applicable thereto. Certain "equivalent" values, as defined below, may, however, be used in many instances, for the purpose of approximate representation and calculation.

Crest-Factor or *Peak-Factor.* The ratio of the crest or maximum value to the r.m.s. value. The crest factor of a sine-wave is $\sqrt{2}$.

Form Factor. The ratio of the r.m.s. to the algebraic mean ordinate taken over a half-cycle beginning with the zero value. If the wave passes through zero more than twice during a single cycle, that zero shall be taken which gives the largest algebraic means for the succeeding half-cycle. The form factor of a sine-wave is 1.11.

Equivalent Sine-Wave. A sine-wave which has the same frequency and the same r.m.s. value as the actual wave.

Phase-Difference: Lead and Lag. When corresponding cyclic values of two sinusoidal alternating quantities of the same frequency occur at different instants, the two quantities are said to differ in phase by the angle between their nearest corresponding values; *e.g.,* the phase angle between their nearest ascending zeros or between their nearest positive maxima. That quantity whose maximum value occurs first in time is said to lead the other, and the latter is said to lag behind the former.

Non-Inductive Load and Inductive Load. A *non-inductive* load is a load in which the current is in phase with the voltage across the load. An *inductive* load is a load in which the current lags behind the voltage across the load. A *condensive* or *anti-inductive* load is one in which the current leads the voltage across the load.

Power in an Alternating-Current Circuit. The average value of the products of the coincident instantaneous values of the current and voltage for a complete cycle, as indicated by a watt-meter.

Volt-Amperes or Apparent Power. The product of the r.m.s. value of the voltage across a circuit by the r.m.s. value of the current in the circuit. This is ordinarily expressed in kv-a.

Power Factor. The ratio of the power to the volt-amperes. In the case of sinusoidal current and voltage, the power factor is equal to the cosine of their difference in phase.

Equivalent Phase Difference. When the current and e.m.f. in a given circuit are non-sinusoidal, it is customary, for purposes of calculation, to take as the "equivalent" phase difference, the angle whose cosine is the power factor (see above) of the circuit. There are cases, however, where this equivalent phase difference is misleading, since the presence of harmonics in the voltage wave, current wave, or in both, may reduce the power factor without producing a corresponding displacement of the two wave forms with respect to each other; *e.g.,* the case of an a-c. arc. In such cases, the components of the equivalent sine waves, the equivalent reactive factor and the equivalent reactive volt-amperes may have no physical significance.

Single-Phase. A term characterizing a circuit energized by a single alternating e.m.f. Such a circuit is usually supplied through two wires. The currents in these two wires, counted positively outwards from the source, differ in phase by 180 degrees or a half-cycle.

Three-Phase. A term characterizing the combination of three circuits energized by alternating e.m.f.'s, which differ in phase by one-third of a cycle; *i.e.,* 120 degrees.

Quarter-Phase, also called Two-Phase. A term characterizing the combination of two circuits energized by alternating e.m.f.'s which differ in phase by a quarter of a cycle; *i.e.,* 90 degrees.

Six-Phase. A term characterizing the combination of six circuits energized by alternating e.m.f.'s, which differ in phase by one-sixth of a cycle; *i.e.,* 60 degrees.

Polyphase. A general term applied to any system of more than a single phase. This term is ordinarily applied to symmetrical systems.

Plant Factor. The ratio of the average load to the rated capacity of the power plant, *i.e.,* to the aggregate ratings of the generators.

The Demand of an Installation or System is the load which is drawn from the source of supply at the receiving terminals averaged over a suitable and specified interval of time. Demand is expressed in kilowatts, kilovolt-amperes, amperes, or other suitable units.

The Maximum Demand of an Installation or System is the greatest of all the demands which have occurred during a given period. It is determined by measurement, according to specifications, over a prescribed time interval.

Demand Factor. The ratio of the maximum demand of any system or part of a system, to the total connected load of the system, or of the part of system, under consideration.

Magnetic Degree. The 360th part of the angle subtended, at the axis of a machine, by a pair of its field poles. One *mechanical degree* is thus equal to as many magnetic degrees as there are pairs of poles in the machine.

The Variation in Alternators or alternating-current circuits in general, is the maximum angular displacement, expressed in electrical degrees (one cycle = 360 deg.) of corresponding ordinates of the voltage wave and of a wave of absolutely constant frequency equal to the average frequency of the alternator or circuit in question, and may be due to the variation of the prime mover.

The Pulsation in Prime Movers, or in the alternator connected thereto. The ratio of the difference between the maximum and minimum velocities in an engine-cycle to the average velocity.

Capacity. The two different senses in which this word is used sometimes leads to ambiguity. It is therefore recommended that whenever such ambiguity is likely to arise, the descriptive term *power capacity* or *current capacity* be used, when referring to the power or current which a device can safely carry, and that the term *"Capacitance"* be used when referring to the electrostatic capacity of a device.

Resistor. A device, heretofore commonly known as a resistance, used for the operation, protection, or control of a circuit or circuits.

Reactor. A coil, winding or conductor, heretofore commonly known as a reactance coil or choke coil, possessing inductance, the reactance of which is used for the operation, protection or control of a circuit or circuits.

Efficiency. The efficiency of an electrical machine or apparatus is the ratio of its useful output to its total input.

[For the complete revised Standardization Rules of the A.I.E.E. address the Secretary, Mr. F. L. Hutchinson, 33 W. 39th St., New York.—Ed.]

TABLE I.

Symbols and Abbreviations.

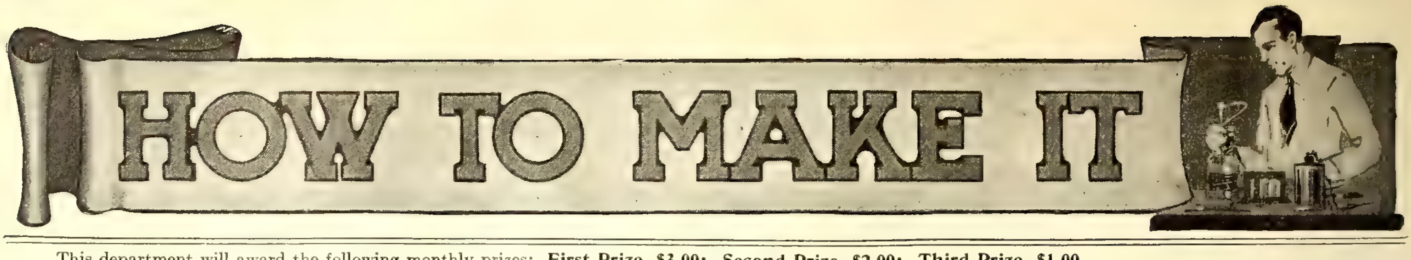
Name of Quantity.	Symbol for the Quantity.	Unit.	Abbreviation for the Unit.
Electromotive force, abbreviated e.m.f.	E, e	volt	....
Potential difference, abbreviated p.d.	V, v or E, e	"	....
Voltage	E, e or V, v	"	....
Current	I, i	ampere	....
Quantity of electricity	Q, q	coulomb, ampere-hour	....
Power	P, p	watt	....
Electrostatic flux	Ψ	....	....
Electrostatic flux density	D	....	....
Electrostatic field intensity	F		
Magnetic flux	Φ, Ψ	maxwell**	....
Magnetic flux density	B, β	gauss**	....
Magnetic field intensity	H, $\mathcal{H}$	gilbert per centimeter or gauss††	gilbert per cm. ....
Magnetomotive force, abbreviated m.m.f.	$\mathcal{F}$	gilbert*	....
Intensity of magnetization	J	....	....
Susceptibility	$k=J/H$	....	....
Permeability	$\mu=B/H$	....	....
Resistance	R, r	ohm	....
Reactance	X, x	"	....
Impedance	Z, z	"	....
Conductance	g	mho	....
Susceptance	b	"	....
Admittance	Y, y	"	....
Resistivity	ρ	*ohm-centimeter	ohm-cm.
Conductivity	γ	*mho per centimeter	mho per cm
Dielectric constant	ε or k	....	....
Reluctance	$\mathcal{R}$	....	....
Capacitance (Electrostatic capacity)	C	farad	....
Inductance (or coefficient of self induction)	L	henry	....
Mutual Inductance (or coefficient of mutual induction)	M	henry	....
Phase displacement	θ, Ψ	degree or radian	
Frequency	f	cycle per second	~
Angular velocity	ω	radian per second	....
Velocity of rotation	n	revolution per second	rev. per sec.
Number of conductors or turns	N	convolution or turns of wire	
Temperature	T, t, θ	degree centigrade	°C.
Energy, in general	U or W	joule, watt-hour	....
Mechanical work	W or A	joule, watt-hour	....
Efficiency	η	per cent	....
Length	l	centimeter	cm.
Mass	m	gram	g.
Time	t	second	sec.
Acceleration due to gravity	g	centimeter per second per second	cm. per sec. per sec.
Standard acceleration due to gravity (at about 45 degrees latitude and sea level) equals 980.665†	g_0	centimeter per second per second	cm. per sec. per sec.

**An additional unit for m.m.f. is the "ampere-turn," for flux the "line," for magnetic flux-density "maxwells per sq. in."

††The gauss is provisionally accepted for the present as the name of both the unit of field intensity and flux density, on the assumption that permeability is a simple numeric.

* *Note.* The numerical values of these quantities are *ohms resistance* and *mhos conductance* between two opposite faces of a cm. cube of the material in question, but the correct names are as given, not ohms and ohm sper cm. cube as commonly stated.

†This has been the accepted standard value for many years and was formerly considered to correspond accurately to 45° Latitude and sea level. Later researches, however, have shown that the most reliable value for 45° and sea-level is slightly different; but this does not affect the standard value given above.



This department will award the following monthly prizes: **First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.**

The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of **$3.00** is awarded; for the second best idea a **$2.00** prize, and for the third best a prize of **$1.00**. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

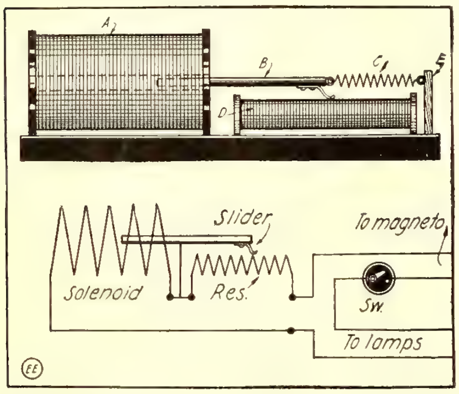
FIRST PRIZE, $3.00

AUTOMATIC RESISTANCE FOR "FORD" HEAD-LAMPS.

This automatic resistance was used with entire success by the author, and I thought that someone else might have use for such a wrinkle. In the illustration A is a solenoid about six inches long and two inches in diameter. A small paper tube is first made and ends fitted on, then it is wound full with No. 18 magnet wire. B is a small piece of soft iron that will fit loosely inside the tube. Some resistance wire is then secured and wound on a tube about the same length as the solenoid. F is a small upright which holds a retractile spring C. It is all mounted on a base as shown and connected as per diagram.

The action is thus: The current passing through the solenoid draws in the core, which carries a small slider making contact on the resistance wire. This action varies the current supplied to the lights on the car. When the current becomes less the spring C draws the core out and decreases the resistance and vice versa.

Contributed by H. S. OGDEN.



An Automatic Voltage Regulator for Ford and Other Cars. Connected in the Magneto Circuit, the Solenoid Coil "A," Acts to Pull in the Iron Bar "B" as the Voltage Increases, Thus Inserting More Resistance Into the Lamp Line. The Life of the Lamps Is Thereby Greatly Lengthened.

A LOOSE-COUPLER TUNING WRINKLE.

The question of fitting taps for couplers, which require individual turn tuning, often causes considerable trouble. If, however, taps are taken in the usual manner from each second, or each third convolution and a special coil of one, or two turns, with a separate switch, is placed on the end of primary tube, this difficulty is overcome and any possible number of turns can be used. This method will greatly decrease the number of taps, and consequently the cost.

Contributed by F. C. HAMILTON.

SHOP KINKS.

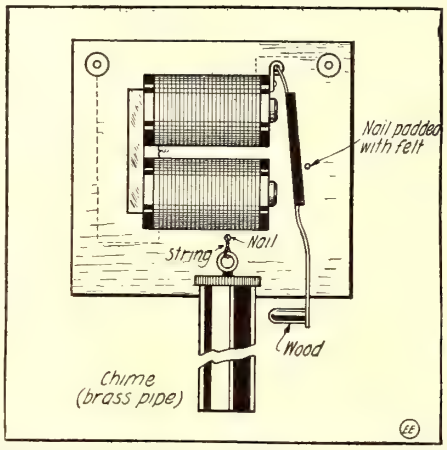
In drilling wrought iron or steel, always use plenty of oil. Lard oil is commonly used for such work. The oil helps to carry away the heat. When drilling or boring in cast iron, no oil is necessary. Light drilling in brass requires no oil, but fairly heavy drilling should have oil. Copper is one of the toughest materials and should receive plenty of oil. To drill large holes accurately, use a small drill first.

SECOND PRIZE, $2.00

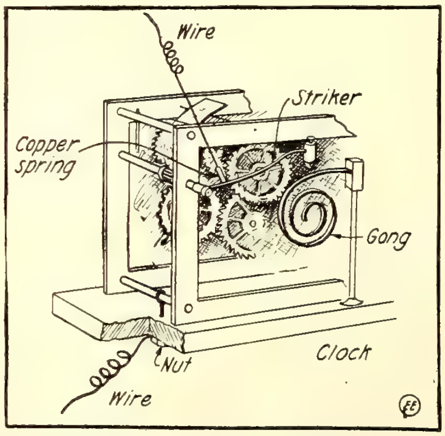
A CHIME RINGER FOR THE HOME.

To a clock placed in the hall an electric chime ringer may be so connected that when the clock strikes the chime rings in a room upstairs, etc. The chime ringer is very simple to make, consisting of an ordinary vibrating electric bell, with the vibrator removed, so as to give a single stroke. The bell is also removed and chimes substituted. The clock connections are very simple and easily made. Referring to the illustration, you will note that one wire is grounded to the frame of the clock movement, while the other is connected to a very thin copper spring, which is placed just above the striker. This enables it, when raised, to strike the gong. This is a very simple but ingenious idea, and may be used with practical results.

Contributed by CLEM O. ENOS.



Those Who Like Electric Novelties for the Home Will Find This Chime Ringer, Actuated by the Hall Clock, a Useful and Pleasing Innovation.



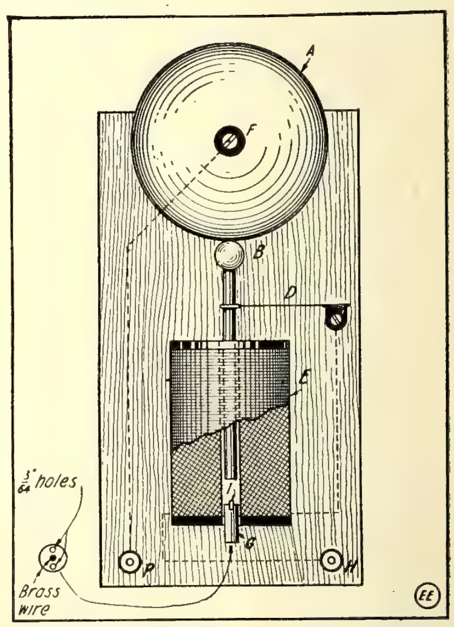
Electrical Contact Spring Arranged on Clock, so that Whenever Striker Arm Descends, It Makes Momentary Contact with Copper Spring.

THIRD PRIZE, $1.00

A SIMPLE ELECTRIC BELL FOR THE EXPERIMENTER.

The base of this bell consists of a board 6" long, 3" wide and ½" thick. The bell A is 2½ to 3" in diameter and is placed as shown. A coreless electro-magnet E, having a ¼" hole in it, is placed in the center of the board 1" up. The plunger is made from a soft iron rod 7/32" diameter and 2" long with a 5/16" ball B secured to it. It is held in place by a spring D. The binding post P, is connected to the gong support F, with a piece of wire. The electro-magnet is connected to the binding post H and the spring D; G is a plug of soft iron about ¼x¼". It has three holes in it, one 1/16" in diameter, the middle, containing a piece of brass wire I; and two 3/64" holes used as vents.

Contributed by ROBERT T. CRANE.



Simple Electric Bell which Can Be Easily Made by the Amateur Electrician. Silver or Platinum Contacts Will Greatly Improve It.

LEYDEN JAR HINT.

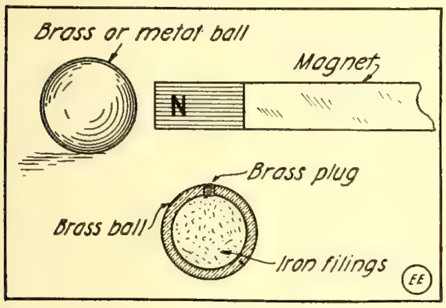
Following is a little wrinkle which may be useful to the readers of THE ELECTRICAL EXPERIMENTER. In constructing a Leyden jar condenser I experienced trouble in shellacking the tin-foil on the inside of the jar. Finally I placed the shellac on the glass, then rolled up the tin-foil on a stick and put it in the jar. With a little carefully manipulation the foil was spread evenly around the inner face of the jar. Then a quantity of lead shot (fine shot preferable) was poured into the jar, which kept the foil prest tightly against the glass. When dry the shot was removed. Good adhesives for such work are thin shellac, banana oil, or thin glue.

Contributed by C. G. E.

A MYSTIC MAGNETIC "BRASS" BALL.

Here is a *brass* ball that is really capable of being attracted by a magnet. Impossible! you say? Well, then, take a glance at the Fig. and be convinced otherwise or, if still skeptical, try the experiment yourself. A hollow brass ball filled with iron filings and a bar or horseshoe magnet will do the trick.

All students of electricity are aware that ordinarily a magnet will not attract a brass ball. The insertion of iron filings, however, overcomes this difficulty very simply. In view of the above the performance of this experiment will prove a puzzle to those



Did You Ever See a Magnet Attract a "Brass" Ball?—Then Read This Article!

"fellow-muckers" who are not in on the secret. Try it on them the next time you have the chance.

Contributed by
JOHN T. DWYER.

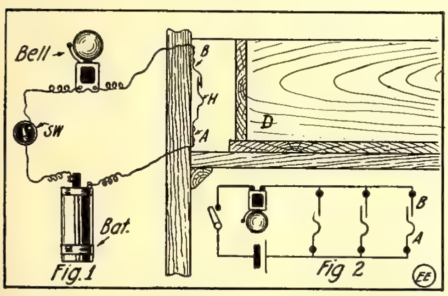
A HOME-MADE DRAWER ALARM

The materials needed are scraps of springy sheet copper or brass, some insulated wire about No. 18 for connections, two dry cells, an ordinary door bell and a few small wood screws.

From the sheet copper cut two strips ½" wide and 4" long and bend these to the shape shown in Fig. 1.

Attach the two strips inside the furniture containing the drawer, and just back of the drawer, by the wood screws as shown in figure.

Adjust the hump H, of the spring A, in height so that when the drawer D, is closed it will press against H and cause the ends of A and B to separate about ¼". Now when the drawer is opened even ¼" it will allow A to spring against B. thus closing the circuit and ringing the bell until the drawer is shut.



When the Drawer Is Pulled Out the Least Bit, the Switch Spring Closes and Rings the Bell.

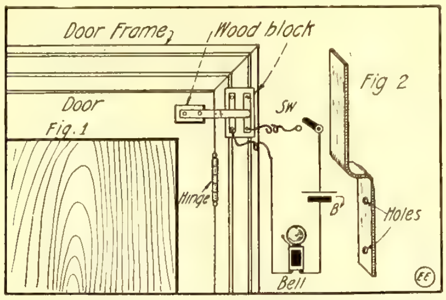
It is well to put a switch SW in the circuit and conceal it near by so that the owner can open the drawer without actuating the alarm. Any number of drawers can be made to ring the same bell by connecting all of the A strips to one wire and all of the B strips to the other wire as shown in Fig. 2.

As none of the apparatus is on the drawer the connections are not as likely to be broken as when they depend on flexible wire.

Contributed by BRUCE McMANAMY.

ALARM THAT RINGS WHEN DOOR OPENS.

To make this simple but effective door alarm procure two pieces of wood, one piece 3"x1"x⅛", and the other piece



How to Rig Up a Simple Electric Bell Alarm on Your Door. Opening the Door Causes the Circuit to Be Closed.

4"x1"x⅛". Then obtain three pieces of sheet brass or phosphor bronze, two of them to measure 3"x¼" and one 5"x¼". Bend the longer strip to the shape shown in Fig. 2. Nail it upon piece of wood 4"x1"x⅛", and screw this part of the alarm on the door, as shown in Fig. 1. Next take the other two contact strips and punch three holes in each of them as shown. Nail these upon the piece of wood 3"x1"x⅛" and screw it fast to door frame as shown in figure. Make connections as indicated. Now when the door is swung open the metal brush upon the door bears against the two fixt contacts on door frame, forming a circuit and ringing the bell. When you do not want the alarm to ring, throw off switch.

Contributed by
WILLIAM A. NICHLERS.

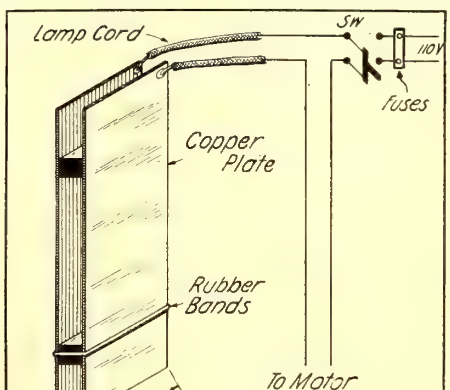
CONSTRUCTING RESISTANCE UNIT FOR SMALL MOTORS AND LAMPS.

Herewith is a plan and description of a simple resistance to be placed in series with battery lamps, motors, spark coils, bells, etc., on the 110 volt line current.

Cut two pieces of copper, zinc or tin 6x1 inches and solder a piece of lamp cord to each strip, long enough to reach to the apparatus to be operated and the switch.

Then take 2 pieces of fiber ¼ inch square by 1 inch long (the crossbar of an old switch is excellent), place them between the two metal plates and bend firmly together with a few stout rubber bands.

When all is ready take a glass jar of about one pint capacity and fill it with water. Connect the two plates in series with motor or other apparatus on the 110 volt line and place the plates slowly in the water. The



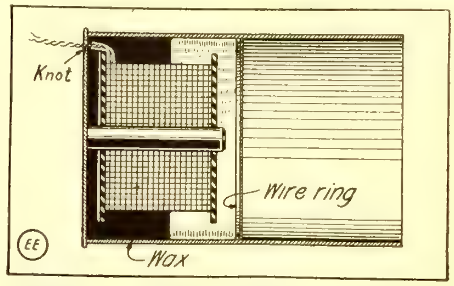
A Resistance Unit Easily Made from Two Pieces of Copper Separated by Wood Strips, the Whole Device to Be Immersed in Water.

farther down you put the plates, the more current you will get. A little salt added to the water makes it more conductive. To make a fixt unit of this device a paste of lamp-black or powdered carbon and shellac may be placed between the plates and allowed to harden.

Contributed by
CECIL H. OSTERMEIER.

A SIMPLE TELEPHONE RECEIVER.

A simple telephone receiver may be made by taking an old ½-lb. baking-powder can and soldering a ring made of heavy wire on the inside, about 1 5/16 inches from the bottom. The magnet can be made from a piece of round hardened steel, 3/8 inch in diameter and 1¼ inches long. This core is then wound with about



A Telephone Receiver Suitable for Experimental Telephony Is Readily Made from a Tin Can, an Electromagnet and a Tin Diafram.

250 feet of No. 36 insulated copper wire, the ends of which are soldered to a piece of lamp cord, passed through a hole in the bottom of the can and knotted on the inside to prevent pulling out.

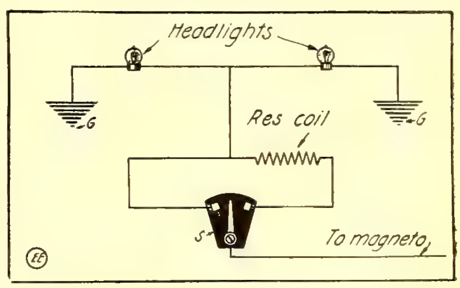
A disk of thin sheet iron should be cut to the diameter of the can, taking extreme care not to bend it. The magnet is then placed in the bottom of the can in an upright position and enough melted beeswax and resin mixture poured in to hold it in place. After the wax has hardened, the disk is slipt in and fastened tightly by a ring of solder.

Contributed by
LLEWELLYN ABBOTT.

DIMMING IDEA FOR "FLIVVERS"

Fords running with lights connected in series are always in danger more or less. The device described below will enable the driver to make his way without danger.

Take a tap from the wire connecting the two head-lights together and run it to one point of a two-point switch (s); the switch blade is connected to the magneto. The other point is connected to a resist-



Dimming Idea for Auto Head-lights—a Resistance Coil in One Side of the Circuit Does the Trick.

ance coil for the purpose of dimming according to city regulations. The diagram shows the necessary wiring. The resistance coil may consist of a few feet of No. 20 German silver or iron wire, the proper length being found by experiment. The wire can be wound on a porcelain or wood core and suitably fastened in an inconspicuous location, as under the engine bonnet on the dash.

Note that 12-volt bulbs must be substituted in place of the regular 6-volt lamps.

Contributed by GEORGE McBETH.

Experimental Chemistry

By Albert W. Wilsdon

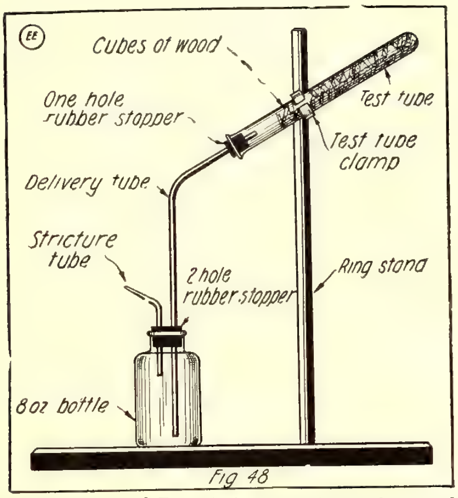
Tenth Lesson

CARBON.

CARBON exists in the free state in nature in three modifications: [1] The diamond; [2] Grafite, and [3] Amorphous Carbon.

The Diamond:—

The diamond is a crystallized form of carbon, found in various colors, from white



Arrangement of Test Tube Containing Cubes of Wood for Experiment in "Destructive Distillation"

to colorless, through yellow, red, orange, green, blue or brown to black. It is composed of pure carbon, and can be completely burned by fastening it with platinum in a jar of oxygen, between two poles of a battery and passing a powerful electric current over it. It is the hardest substance known, being able to scratch all other minerals, and glass.

The uses of the diamond are:

[1] As a gem;

[2] The powder is used for polishing others;

[3] Larger specimens are used in mining for boring or drilling, and is known as the *Diamond Drill;*

[4] Small fragments are set and used by glaziers for cutting glass;

[5] They are also used by engravers for etching-points.

Grafite:—

Grafite is another crystallized form of carbon, having an iron-black to dark steel gray color, with a metallic luster. To the touch it is a soft, greasy substance. It is composed of carbon, either pure or with an admixture of iron, or occasionally of silica, alumina, and lime. Grafite is sometimes called *Black-Lead* tho there is no lead, even as an impurity in its composition.

It is used:—

[1] For the manufacture of pencils, the hardness and softness of which depend upon the percentage of grafite used, and also upon the pressure;

[2] As a lubricant;

[3] As a lining for crucibles in making steel;

[4] As a polish for gunpowder;

[5] In the foundry to make smooth castings;

[6] The refractory nature permits its use in crucibles for melting metals;

[7] For the electrodes of electric furnaces.

Amorphous Carbon:—

[A] CHARCOAL:—

This is an impure variety of carbon prepared from vegetable substances or bones [Boneblack].

Wood charcoal is black, very porous, absorbs gases readily, removes color from organic liquids, and burns in the air at red heat, forming Carbon Dioxid [CO_2]. When burned in a retort without the access of air, or in other words, by a process termed *Destructive Distillation,* the hydrocarbons, etc., are removed. During this process the compounds contained in the wood are broken up by the application of heat, and volatile gases are liberated. These gases consist of volatile hydrocarbons [which are compounds of carbon and hydrogen, and are combustible], pyroligneous acid, water vapor, carbon dioxid, etc.

It is made on a large scale by building up billets of wood into a conical heap and covering them with earth or sand. This heap is then ignited at openings near the bottom of the pile and the gases escape at small openings above.

Charcoal is used:—

[1] For heating purposes;

[2] As a filtering material;

[3] As a polishing powder;

[4] As a defactator and decolorizer of solutions and water;

[5] As an absorber of gases and aqueous vapors;

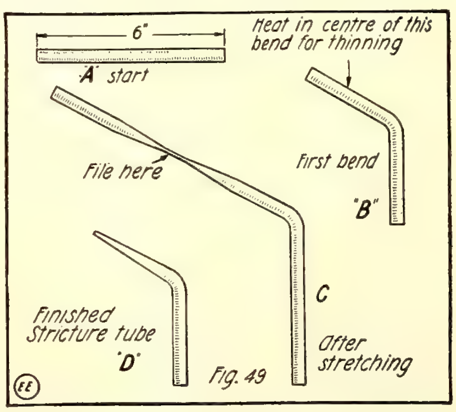
[6] As a constituent of gunpowder and fireworks;

[7] As a purifier of water in filters, etc.

EXPERIMENT NO. 35—

Arrange the apparatus as shown by Fig. 48. Fill a test tube with splinters or cubes of wood and connect the delivery tube to it by passing the tube thru a one-hole rubber stopper as shown. Set the test tube on the ring stand, at the angle shown, and pass the other end of the delivery tube thru a two-holed rubber stopper in an 8-ounce bottle. Next take a piece of glass [about 6 or 7 inches long] and first bend it as shown by Fig. 49-B, and allow to cool. After it is cold, hold the short end of the bend in the flame of a Bunsen burner [with a fish-tail attachment] until the glass softens. Then take it from the flame, and pull it so that the glass has thinned down to a very fine thread as shown by Fig. 49-C. The tube thus prepared is then filed off so that the finished stricture tube is similar to that shown by Fig. 49-D. This leaves the tube with a minute hole at the end.

After the apparatus is set up as shown, apply the heat of a Bunsen burner to the test tube containing the cubes of wood, by keeping the flame in constant motion over

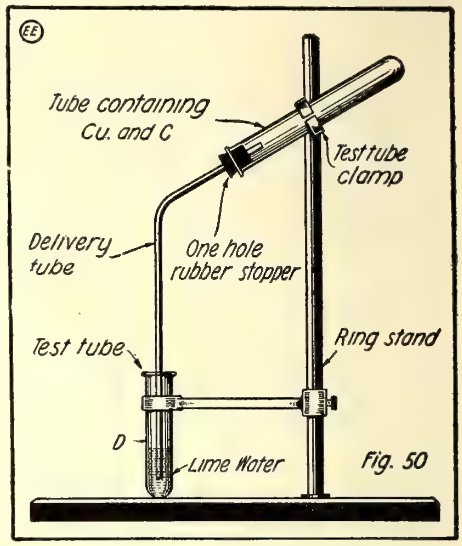


Showing Various Steps to be Followed in Making Glass Stricture Tube, for Use in Conducting Experiments Here Described.

the whole of the tube where the wood is. Never allow the flame to remain in one position as the glass of the tube will soften and finally crack.

Notice the color of the fumes passing over the delivery tube. Also the liquid in the bottle. After the action has been going for some time, apply a light to the end of the stricture tube. What is the result?

After the action is complete, allow the apparatus to cool and examine the contents of the test tube. This substance is charcoal. How does it differ from the original wood?



Apparatus for Experiment No. 39, the Test Tube Containing Copper Oxid (CuO) and Powdered Charcoal (C). Gas Liberated Upon Heating the Upper Tube Is Identified by Passing It Thru Lime Water.

Test the liquid in the bottle with both red and blue litmus paper. Record your results. The decomposition of material into simpler substances by means of heat is called *Destructive Distillation.* The three products obtained by the destructive distillation of wood are—a gas; a liquid; and charcoal.

Boneblack [also called Animal Charcoal]:

This is obtained in a similar manner to charcoal, namely by the destructive distillation of bones in a closed retort. In this case the volatile portions consisting of water, ammonia, etc., are driven off and the finely divided carbon is disseminated thru the porous calcium phosphat left behind. It has the power of absorbing gases, removing the coloring matter and alkaloids, etc., from their solutions.

It is used:—

[1] To decolorize organic substances and especially in the refinement of sugar.

[2] It has also been used to disinfect ulcers, etc.

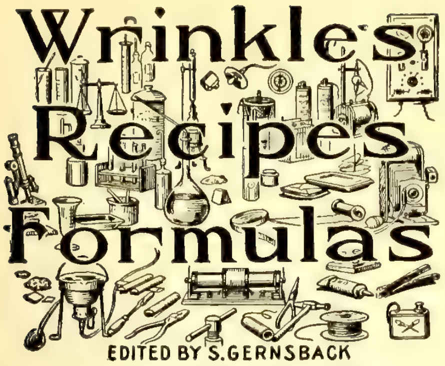
EXPERIMENT NO. 36—

With a new set of apparatus the same as used in the foregoing experiment, and in place of the wood fill the test tube with animal bones. Heat as before, and record your results. Test the gas at the end of the stricture tube by applying a flame. What were the results? After the heating is complete, and the apparatus cooled, examine the substance which remains in the test tube. Apply all of the foregoing tests and compare the results with those of the foregoing experiment.

Lampblack:—

Lampblack is practically pure carbon, and is nothing more than pure soot, such as can be readily seen when a kerosene lamp *smokes.* It is a velvety, jet-black powder very finely divided, and shows no traces of crystallization. It is formed by igniting various oils, which are mostly hydrocarbons, and collecting the unburned carbon or smoke.

(*Continued on page 859*)



EDITED BY S. GERNSBACK

Under this heading we publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

EXPERIMENTER'S APHORISMS

In the following, we wish to give to the Experimenter some hints as to the use of the different ingredients and how to work them:

(1) Always bear in mind that exact working of a formula requires ACCURACY, CLEANLINESS, PATIENCE, and SKILL.

(2) Know what you are about, before you start to experiment.

(3) "THE HISTORY OF FAILURES IS THE HISTORY OF SUCCESS" goes an old adage, and it applies well to the experimenter.

(4) Many times impure, wrong or deteriorated raw materials, spell FAILURE instead of SUCCESS.

(5) A great many of the chemicals and ingredients required, cannot be obtained from drug stores; buy them at a reputable supply house.

(6) BEFORE CONDEMNING A FORMULA, be sure the fault does not lie with the manner of handling it, or the purity of the ingredients.

(7) Be sure to mix the materials comprising a certain formula in the proper sequence.

(8) When starting to prepare a mixture, especially one containing liquids, ask yourself: "IS THE SPECIFIC GRAVITY CORRECT, AS INDICATED BY A HYDROMETER? IS THE TEMPERATURE RIGHT? IS THE QUANTITY OR WEIGHT RIGHT?

(9) Acids and water, when mixed, should be manipulated in the proper manner, i. e., THE ACID SHOULD BE POURED INTO THE WATER, and not vice versa, as the solution is liable to be forcibly ejected from the containing vessel and into the mixer's face.

(10) For any kind of SYSTEMATIC WORK, a floating THERMOMETER and HYDROMETER, as well as measuring glasses and scales, should always be provided, as GUESSWORK is EXPENSIVE, and SOMETIMES FATAL.

(11) Put labels on ALL bottles, boxes and packages with FULL INSCRIPTION as to their contents, it will avoid troubles and mistakes.

(12) Remember that a beginner cannot expect to make articles AT FIRST, which will compare with regular manufactured products. S.G

A MAGIC FIRE FLUID.

The magician appears with a small bottle of colorless liquid in one hand and a few pieces of white paper in the other. He proceeds to pour a little of the fluid on the paper and then places the paper on a screen or some other metal support.

Then he steps back; in the meantime explaining to the audience that this magic fluid, invented by the Japanese thousands of years ago, was used by them to torture their prisoners, or relating any similar story to keep the audience interested. In a few minutes, usually about two, the paper will burst into flame spontaneously. The trick is very mystifying to any one who does not understand the principles involved.

However, it is really very simple. The fluid is prepared by dissolving phosphorous in carbon di-sulfid. Be extremely careful in handling the phosphorous, to cut it under water and not to touch it with your hands. Also keep the carbon di-sulfid away from open flames, as it is very inflammable. The odor of the commercial product is rather disagreeable, but this may incidentally add to the mystery of the trick.

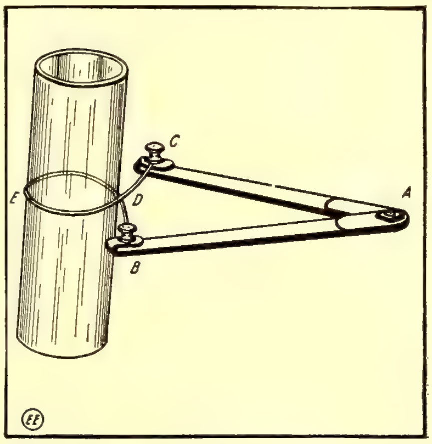
What really happens is this: The phosphorous is dissolved in the carbon di-sulfid. When poured on the paper the carbon di-sulfid evaporates, leaving the phosphorous impregnated in the paper (in a finely divided form). This starts to oxidize and soon raises the temperature of some part of the paper to the kindling point.

Practically any kind of paper will do for this trick. Filter and newspaper both work well. The main thing is not to spill it on anything that you do not wish to burn as it works 100 per cent of the time.

Contributed by
GEORGE W. GREENE.

ELECTRIC GLASS JAR CUTTER

Procure two brass or iron rods, 7" long by ¼" diameter. Flatten them out slightly at both ends and drill holes, just large enough to pass a battery bolt, ¼" from the ends as shown. Notice that at one end the rods are flattened for about ¾" so that they can be almost closed. The rods are fastened together at A with a battery bolt and two nuts. A third nut serves to hold the wire lead. The arms should work smoothly. Battery bolts are inserted at B and C and a piece of German Silver or other resistance wire, connected at B, forms a loop and in turn is connected at C. The length of wire and size remains with the experimenter, depending upon the current available. No. 22 German Silver wire will suffice for use on a step down transformer of about 8 volts.



An Electric Glass Tube and Jar Cutter—Current Is Past from "E" to "A", Heating Wire, when Glass Is Wetted at the Point where Wire Encircled It.

To cut a glass jar, grip the instrument in the right hand with the two fingers between the two arms so that they can be spread further apart if necessary. The loop of wire is placed around the jar at the point at which it is to be cut and held taut. One lead from the source of current is connected at A and the other is held in the left hand and touched at point E on the wire for a few seconds. For best results the wire should almost reach a red heat. After being left in place for a few seconds dash a little cold water against the heated glass. A clean break should result.

Contributed by W. P. RATHERT.

MISCELLANEOUS FORMULAES

To Poison Rats.—Mix together 2 ozs. of carbonat of barytes with 1 oz. of lard and lay it in their way. Also put a dish of water near, as it causes great thirst and as soon as they drink they die instantly.

To Preserve Dead Pets.—One lb. of dry sulfate of aluminum, one-fifth of a quart of water and twenty grains of arsenous acid, well mixed. Inject this into all the vessels of the body and you can thus preserve cats, dogs, birds, fish, etc.

Trick Cigarette Papers.—Take common cigarette papers and dip them into a solution of saltpeter and water; be sure they are thoroly impregnated, then lay them out to dry. When they are dry replace them in their original package and hand them to a friend. He will receive the surprise of his life

Fulminating Powder.—Mix together in a warm mortar one part of saltpeter, two parts sulfur. Place on the edge of a fire shovel and hold over the fire. It will turn black and explode with a loud report.

Contributed by
JOHN D. COLEMAN.

INK RECIPES.

Everlasting Black.—Tannic acid, 1 oz.; crystal gallic acid, 77 grs.; sulfate of iron, 5 drs.; gum arabic, 100 grs.; dilute muriatic acid, ½ oz.; Carbolic acid and water (acid 10 drs.; water, 1¼ pints). Mix the acid and water and dissolve the other ingredients therein. This ink will not fade.

Red Ink (Bright).—Dissolve 25 parts of saffron in 500 parts of warm glycerin, then stir carefully in 500 parts of alcohol and 500 parts acetic acid. It is then diluted with 9,000 parts of water, to which a little gum arabic may be added.

Gold Ink.—Fine bronze powder is mixed with a little sulfate of potash and water; the precipitate is mixed with water and a sufficient amount of gum

Green Ink.—Rub 3 drs. of Prussian blue and 6 drs. gamboge with 4 ozs. mucilage and a pint of water.

Silver Ink.—Silver leaf ground with a little sulfate of potash is washed from the salt and mixed with water and a small amount of gum acacia.

White Ink.—Triturate together one part honey and two parts of dry ammonia alum. Dry thoroly and calcine in a shallow dish over a fire until perfectly white. Cool, wash, rub up with sufficient gum and add water for use as ink.

Vanishing Ink.—This ink consists of an aqueous solution of iodide of starch. Characters written with it completely vanish in about four weeks.

Cement (Acid Proof).—Asbestos, 2 parts; sulfate of barium, 3 parts; silicate of sodium, 2 parts. Mix thoroly and the result will be a cement for all purposes that will resist the strongest acids.

Diamonds (Imitation).—White sand, 900 parts; red lead, 600 parts; pearl ash, 450 parts; niter, 300 parts; arsenic, 50 parts; manganese, one-half part. Melt and pour into cold water. To make it harder use less lead and if it has a yellow tint use more manganese.

Contributed by
RICHARD GAILLARD.

HOW TO MAKE ALLOYS.

For Clichés or Printing Plates.—Tin, 48 parts; lead, 32.5 parts; bismuth, 10.5 parts; antimony, 9 parts.

For Candlesticks, Spoons, Vessels.—Tin, 80 parts; lead, 20 parts.

For Imitation Silverware.—Tin, 92 parts; lead, 8 parts.

For Pieces of Jewelry; or Substitute for Silver.—Tin, 80 parts; antimony, 20 parts.

For Fusible Metal.—Bismuth, 50 parts; lead, 30 parts; tin, 20 parts

Brass for Medals.—Copper, 95 parts; tin, 4 parts; zinc, 1 part.

Brass for Cymbals and Kettledrums.—Copper, 80 parts; tin, 20 parts.

Brass for Bells.—Copper, 77 parts; tin, 23 parts.

Substitute for Gold.—Copper, 94 parts; antimony, 6 parts; magnesium carbonat, ⅓ part.

Contributed by
AGUSTIN GALVAN (Mexico).

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month **$3.00** prize for the best photo. Make your description brief and use only one side of the sheet. Address the Editor, "With the Amateurs" Dept.

AMATEUR RADIO STATION CONTEST.

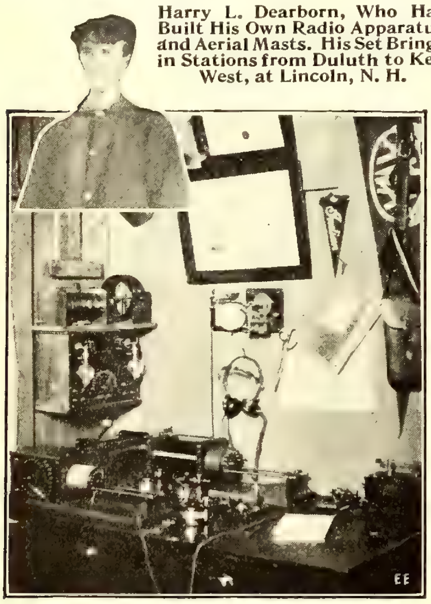
Monthly Prize, $3.00.

This month's prize-winner.

A NEW HAMPSHIRE AMATEUR RADIO WORKER.

I present herewith two photos of my wireless station that I would like to enter in your Amateur Radio Station contest.

Harry L. Dearborn, Who Has Built His Own Radio Apparatus and Aerial Masts. His Set Brings in Stations from Duluth to Key West, at Lincoln, N. H.



The aerial that I now have is 102 feet high and about 250 feet long, composed of two No. 12 copper wires, with a diagonal lead-in of about 100 feet. I use this aerial mostly for receiving.

The set shown consists of two inductive tuners, one of which has a slider and is used for waves up to 3,000 meters; the other has switches on both primary and secondary and is used for short waves up to about 1,500 meters. A loading coil is used and so connected that it can be switched into either primary circuit. Three Murdock variable condensers are used, two of which are of .001 mf., and a small one of .0005 mf., which is connected across the 'phones. A simple galena detector is also used. On the wall over the tuners there is seen a double bulb Audion detector; switches are provided to throw the secondary on either the galena or Audion detector.

Above the Audion dectetor is a variometer that I sometimes use in place of a loader, and the small coil shown is connected to load up the secondary circuit when using the Audion.

I use a pair of Murdock 3,000 ohm 'phones and just above the 'phones is a 15 plate omnigraph that I use when in need of practise.

The transmitting set I now have includes only a 1" coil, gap and key, and I don't very often use it as my aerial is too big for it.

Every bit of the instruments shown with the exception of the 'phones and condensers were built by myself, including all brass work, studs, knobs, etc., and during the past two years I have built a number of sets, mostly cabinets. The set shown in the July issue by Mr. Hunt was built by yours truly also the panel he now has. Am a member of the *Radio League of America* and N.A.W.A.

I am situated in the heart of the White Mountains, hence the high aerial and have had very good success so far, my limit being Key West, Fla. (south), and Duluth, Minn. (west). Have also built a few Audion amplifers with good success. All my instruments are insulated entirely with hard rubber; not a connection touches wood.

The aerial poles are built up in sections of doubled 2" by 4's, bolted together, and each section averages about 16 feet in length. I had to put the poles up alone which was not such a hard job as it looks to be. Eight sets of guy wires—three wires to a set—hold it perfectly steady.

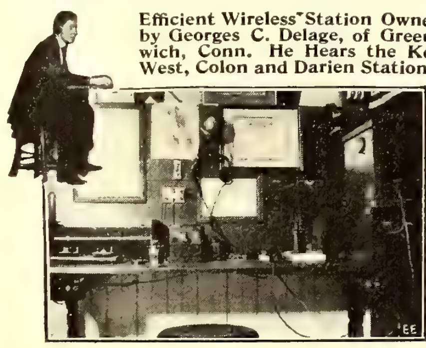
HARRY L. DEARBORN.
Lincoln, N.H.

WIRELESS SET OF GEORGES C. DELAGE.

The transmitter to the right of the change-over switch in the accompanying photograph consists of a ¼ K.W. Clapp-Eastham set on which I have mounted a rotary gap (upper cabinet) and an oscillation transformer, key and motor switch to left of change-over switch.

The receiving (left to right) consists of a large, home-made loading coil, 2 galena

Efficient Wireless Station Owned by Georges C. Delage, of Greenwich, Conn. He Hears the Key West, Colon and Darien Stations.



detectors, detector switch, short-circuiting switch, Mesco variable condenser, E. I. Co., fixt 'phone condenser, Clapp-Eastham loose coupler, Amco variable condenser, buzzer key and 3,000 ohm Holtzer-Cabot 'phones.

There are two aerials, one being 250 feet long, two wires, 5 feet apart and 90 feet high, for receiving only. The other is 85 feet long, 3 wires, 3 feet apart, 80 feet high, made of stranded phosphor bronze wire.

I have worked distances of over 30 miles and have heard Key West, Colon, Darien and Miami. My call is 1VW.

GEORGES C. DELAGE.
Greenwich, Conn.

Has your station photo appeared in "The Electrical Experimenter"? Why not purchase the electrotype and have some "real" stationery printed with your station picture on it? All of the "regular radio-bugs" are doing it.

RADIO "LAB." OF ANDREW L. SHAFER.

My receiving set consists of a 2,500 meter loose coupler, loading coil, Audiotron cabinet (not shown in photograph), galena and Crystaloi detectors, variable condenser shunted across the secondary of the coupler, fixt condensers, Brandes' 'phones and the usual buzzer test. By means of a S.P. S.T. switch, I can connect the loading coil into the primary circuit and it is then possible to receive wave lengths of about 4,000 meters. When using the galena detector I hear NAA very loud; NAA, NAJ, WHK, WCX, WOR, VBB, VBE, and a host of other land, boat and amateur stations. Of course the Audiotron brings in countless others.

For transmitting I use a one-inch spark coil, oscillation transformer, fixt and quenched spark gaps (as alternates), glass plate condenser immersed in castor oil and a heavy key. The current for operating the set is supplied by a 6 V. 60 A.H. storage battery.

I have communicated with 8 NH of St. Marys, Ohio, several times, the distance being thirty-four miles air line. I have worked with 9 WF of Fort Wayne, Ind., once, a distance of thirty-four miles also. 8 NH reported once, "sigs good. You sound like a ¾ K.W." I attribute this good work mainly to natural conditions as there are no hills or large forests to interfere.

My aerial is of the 4 wire, inverted "L" type, 75 feet long, with a spacing of 3 feet, between each wire, supported by two masts 51 feet and 60 feet high, respectively. A very good ground connection is secured thru a copper boiler and an iron plate 2 feet square, each buried 6 feet in damp earth and an iron pipe rammed into the ground 10 feet, all being connected with No. 4 stranded copper cable.

I hold a second grade amateur license and my official call is 8 TE. I should be

Andrew L. Shafer "Listening In" at His Radio Receiving and Transmitting Station Located at Scott, Ohio. He Works Stations 34 Miles Away on a One-inch Spark Coil, Excited by Storage Battery.

very glad to have any one visit my station or to call me by radio.

ANDREW L. SHAFER.
Scott, Ohio.

NEW INTERNATIONAL RADIO LIST.

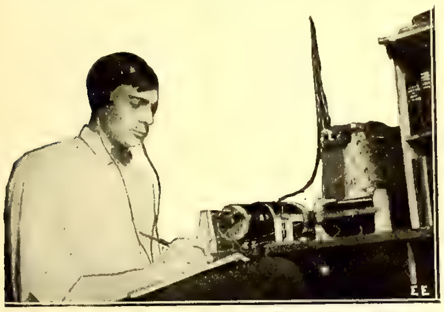
The Berne bureau has announced the completion of the fourth edition of the Liste Alphabetique des Indicatifs D'Appel (Alphabetical List of Call Letters) of the radio stations of the world.

This publication may be procured from the Director, International Bureau of the Telegraph Union, Radiotelegraphic Service, Berne, Switzerland, at the price of 1 franc 30 centimes per copy, plus 35 centimes postage. Remittances should be made by international postal money orders.

RADIO SET OF C. M. PEARSON.

My wireless set is a very simple one, composed of a loose coupler, loading coil, galena detector, fixt condenser and a pair of 2,000 ohm receivers. All are of my own construction, except the condenser and 'phones.

The highest point on the aerial is 42 feet, and the *ground* is made to a spike driven



C. M. Pearson Enjoys His Radio Set, Hearing Arlington (NAA) Daily.

into a tree, the pump and some other miscellaneous earthed metal rods.

I hear Arlington (NAA) every night and can also hear their *time signals* at noon each day.

C. M. PEARSON.

Upland, Ind.

UNCLE SAM TO AID AMATEUR WIRELESS OPERATORS.

For the encouragement of local students of wireless telegraphy, Ensign Philip F. Hambsch of the Albany Navy recruiting station recently announced the willingness of the Navy Department to assist the amateurs in their studies. The purpose of the department's order is said to be for the purpose of educating operators for use in time of war.

The local recruiting station will take steps toward assisting the local wireless organizations.

UKELELE MUSIC BY RADIO.

The following dialogue actually took place between two naval men and was related to ye editors by one who overheard the conversation:

Radio Operator (on a torpedo boat lying off the Carolina coast): "Good morning, Captain; just picked up 'Koko Head.' Some class to our set, what?"

Commanding Officer: "Go 'way with that stuff. Next you'll be telling me you hear the Ukeleles playing in Honolulu!"

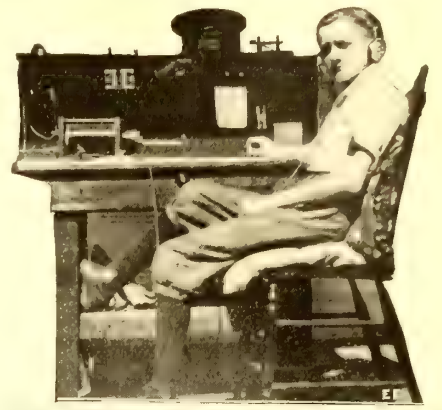
ASKS $400,000 FOR PORTO RICO RADIO.

Secretary Daniels has asked Congress to appropriate $400,000 for a high power wireless station in Porto Rico.

Mr. Daniels said the island is of "extreme strategic importance, in connection with the fleet operations, due to its location, and with a protected high power wireless station communication would be insured with the fleet, with Europe and with South America, to a greater degree than by any other means."

KEITH McKELLIP, A RADIO STAR OF THE WEST.

I have an aerial 70 feet long and 30 feet high. The receiving outfit includes a 3,500



Keith McKellip, a Youthful Radio Enthusiast of Des Moines, Iowa.

meter loose coupler, two crystal detectors, a pair of 2,000 ohm Brandes' 'phones, a fixt condenser and a loading coil.

The sending apparatus comprises a ½ inch coil, a nine-plate condenser, an E. I. Co., spark gap, key and a tuning helix.

I have obtained very good results with this set. I have no license call yet but expect to have one before the season is over.

KEITH McKELLIP.

Des Moines, Iowa.

Amateur News

The Suburban Radio Club of Washington, D.C.

The Suburban Radio Club of Washington, D.C., is holding a large membership campaign by which it hopes to enroll practically every amateur wireless operator in the District of Columbia and vicinity as a member.

The club is making a big effort to dispense with all unnecessary interference this coming spring and will try and impress every amateur with the importance of causing as little interference as possible.

The organization possesses several valuable instruments which are at the disposal of every member. Every amateur in Washington should make it a point to get in touch with the Secretary, Chas. Longfellow, Jr., for further information. Address 5515 Potomac Avenue, N.W., Washington, D.C. The Secretary would be pleased to hear from other Radio Clubs in the United States as to their activities.

The Louisville Radio Club, Louisville, Ky.

During the week of the Kentucky State Fair held at Louisville, some time ago, The Louisville Radio Club was given space in their booth by a local newspaper and a 1 K. W. station was erected. NAA and several other high-powered radio stations were readily heard, while many amateur stations were "worked," much to the delight and interest of the bystanders, and especially to the young ladies who, when they began asking questions, kept those in charge "some" busy.

The exhibit netted the club six new members and prospects of a number of several other members. The Louisville Radio Club has been in existence since March 1916, and now has a membership of about 45, who own and operate stations ranging from a simple 1-inch spark coil set, up to a 1 k.w. rotary gap outfit with a supersensitive receiving set.

The meetings are held on the 1st and 3rd Thursday of each month. Certain members are assigned to read papers and sometimes the meetings are given a social aspect by the two club comedians. I. P. Bohan, Club Reporter, 1410 Stock Building., Louisville, Ky.

The Nassau Radio League, Freeport, L.I.

A short time ago a meeting of radio amateurs of Freeport and Merrick was called by the organizers, Thomas F. O'Brien and Sinclair Raynor at the headquarters, 8 North Main St., Freeport, L.I., N.Y.

The following were elected to hold office until September 11, 1917:—

President, Thomas F. O'Brien, Vice-President, Stephen Carpenter; Secretary, Holmes Swezey and Treasurer, John McCord.

The club affairs are in the hands of an executive committee composed of the officers and three lay members (Clifton Weindek, Stanley Terry and Wilbur Verity) with the President acting as Chairman of the meetings. Chief Operator, Bertram T. Donnelly; 1st Assistant, Sinclair Raynor and 2nd Assistant, Herman Betz.

Business meetings are held the first Friday in each month. Code practice and lectures are given the second, third and fourth Friday in each month. The Tel-Radion Company of New York presented the club with a Detector. Correspondence is solicited. Address the Secretary at the Club Wireless Station, 8 N. Main St., Freeport, L.I., N.Y.

The Experimenter's Radio Association.

The Experimenters' Radio Association of Pittsburgh, Pa., completed a very successful term ending August 29, 1916. The election at the opening of the new quarter placed the following in office:—Ernest A. Munch, President; George Chartener, Secretary, and Paul Schmidt, Treasurer. At the end of the first quarter the club purchased an Electron Relay bulb from the receipts of the previous three months. THE ELECTRICAL EXPERIMENTER, as well as other scientific journals, are kept in the Association Library for the use of the members.

The initiation fee is twenty-five cents, and a fee of ten cents must be paid every week as dues. In return for the above, the members receive weekly lectures, books on Radio Telegraphy and Telephony, etc., as well as the use of the instruments of the Club. For application blank or further information, address Corresponding Secretary, Albert A. Munch, 105 Excelsior St., Pittsburgh, Pa.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur News" Section, The Electrical Experimenter, 233 Fulton St., New York City.

San Francisco Radio Club Making Rapid Progress.

The membership of the San Francisco Radio Club, the only large radio organization in that city, has increased so rapidly that it became necessary to vacate the former club room at 737 Shrader St. and occupy a new large and modern meeting hall at 350 Frederick St., north-east corner of Belvedere St.

The new club room is amply large enough to accommodate 100 persons, and without a doubt the membership will reach the hundred mark by the end of the year. Due to the enormous amount of correspondence to be carried on by the secretary, Mr. H. R. Lee, an assistant Secretary has been elected, Mr. E. W. Radford being the successful candidate.

Plans for the installation of a modern radio station are under way and within due course of time the club room will be equipt with one of the best radio stations in the city.

The club is steadily growing in popularity and an average of ten new members are admitted monthly.

The first edition of the Year Book of the San Francisco Radio Club has been sent to hundreds of addresses; available copies still on hand may be procured from the Secretary, a two-cent stamp to be added in order to lighten the burdensome mailing charges.

Among prominent radio operators recently admitted to the club are Mr. H. R. Spradde of the National Wireless Telephone Co., Mr. F. L. Busch, Radio operator at the Fort Winfield Scott station, and several former marine operators of the Marconi Co.

Meetings are still held as usual, Friday evenings at 8 P.M. Notices and announcements as well as application blanks may be secured from the Secretary, H. R. Lee, 1580 Grove St., San Francisco, Cal.

OFFICIAL LIST LICENSED RADIO AMATEURS NOT TO APPEAR UNTIL NEXT ANNUAL GOVERNMENT CALL BOOK.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of July, 1916. (Continued)

FIRST DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
1OV	Anderson, Albert E.	136 Neponset Ave., Dorchester, Mass.	.5
1OT	Appelin, Gustaf W.	355 Adams St., Dorchester, Mass.	.5
1OP	Baldwin, Philip K.	2 Emerald St., Medford, Mass.	.5
1RT	Baskin, Israel	12 Vale St., Chelsea, Mass.	.5
1QX	Booth, James D.	609 Longmeadow St., Springfield, Mass.	.5
1NX	Brown, Willis C.	Ashland, Mass.	.5
1MX	Calley, Elmer W.	Stonington, Me.	.5
1FO	Davis, Fred R.	99½ Wilmot St., Portland Me.	.5
1DQ	Doughty, Joseph H.	67 Railroad Ave., Greenwich, Conn.	1
1AP	Downing, R. Eugene	107 Grove St., Bangor, Me.	.5
1MH	Eaton, Howard W.	11 Radcliffe Rd., Somerville, Mass.	.5
1DZ	Hammond, George E.	Waverly St., Waterbury, Conn.	1
1EM	Hiorns, Kenneth E.	1 Hill Ave., Pawtucket, R. I.	.5
1DW	Holdick, William	Melrose, Mass.	.5
1HG	Jarret, Leo F.	19 Pawtucket St., Lowell, Mass.	.5
1IU	Krueger, Walter H.	218 W. 7th St., South Boston, Mass.	.5
1GS	McMahon, Earl C.	9 Vernal St., Everett, Mass.	.5
1JH	Martin, Ernest C.	822 River St., Hyde Park, Mass.	.5
1LW	Miller, Robert A.	1314 Main St., Campello, Mass.	.5
1KM	Schleehauf, William W.	27 Armstrong St., Jamaica Plain, Mass.	.5
1DV	Schwichtenberg, Wm. A.	136 Nicoll St., New Haven, Conn.	.5
1BI	Semons, Roger W.	2 Waverly Ave., Saugus, Mass.	.5
1DR	Smith, Percy B.	1332 Main St., Bridgeport, Conn.	.5
1VM	Van Allen, Edward J.	1 Taff Ave., Stamford, Conn.	.5
1EE	Waite, Lawrence A.	333 Narragansett Ter., Riverside, R. I.	.5
1DS	Westmore, Robert E.	376 Elm St., New Haven, Conn.	.5
1OL	Whitmore, John W.	64 Meadow St., Pawtucket, R. I.	.5
1TD	Wilbur, Arthur E.	8 E. Brookline St., Boston, Mass.	.5
1EG	Williams, Walter L.	53 Hart St., New Britain, Conn.	.5

SECOND DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
2ASH	Geoghegan, Thomas V.	Athenia, N. J.	.5
2ASD	Gehret, Ernest G.	2022 Beverly Rd., Brooklyn, N. Y.	.5
2ASN	Koegel, Carl J.	R. F. D. No. 1, Metuchen, N. J.	.5
2ASP	Ruben, Samuel	343 E. 55th St., New York, N. Y.	.5
2ASK	Schwartz, Adolph	1321 Franklin Ave., New York, N. Y.	1
2ASF	Sohnle, Fred	47 Winans Ave., Newark, N. J.	.5
2ASL	Thurston, George	337 W. 14th St., New York, N. Y.	.5

THIRD DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
3GU	Bullock, George A.	915 Edgewood Ave., Trenton, N. J.	.5
3EA	Eaton, George W.	1915 S. 12th St., Philadelphia, Pa.	.5
3AD	Davis, Harley F.	145 W. Hanover St., Trenton, N. J.	1
3JG	Graves, Edwin D.	Marietta, Pa.	.5
3JW	McPherson, John D., Jr.	217 N. 2d St., Easton, Pa.	.5
3FP	Morse, Richard F.	Trenton Junction, N. J.	1
3FK	Smith, F. Lester	1405 Powell St., Norristown, Pa.	1
3CD	Tillinghast, Carlton W.	425 Wood St., Burlington, N. J.	.5
3DT	Williams, Albert J., Jr.	301 South Ave., Media, Pa.	.5

SIXTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
6ABA	Alexander, L. R.	182 Flora St., Los Angeles, Cal.	.5
6AAK	Brinckmann, Fred E.	406 56th St., Oakland, Cal.	.5
6GY	Champion, Walter	714 Pine St., Oakland, Cal.	.5
6ARG	Gerwing, Robert S.	1130 W. 2d St., Santa Ana, Cal.	.5

SIXTH DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
6AHA	Herberger, Arthur L.	1112 Maple Ave., Los Angeles, Cal.	1
6MJ	Hickman, Roger W.	441 N. Painter Ave., Whittier, Cal.	.5
6WC	Kirby, Henri F.	Madrone, Cal.	.5
6WN	Klem, Cleve H.	950 Olive Ave., Coronado, Cal.	.5
6OQ	Lemon, Melville L.	815 N. Hollister Ave., Pasadena, Cal.	1
6MR	Neher, Loyal A.	119½ E. 32d St., Los Angeles, Cal.	.5
6ALB	Stuart, Burton G.	Mayfield, Cal.	.5
6EQ	Robert, Jonathan L.	2063 Meridian Ave., So. Pasadena, Cal.	1
6TN	Snyder, Andy B.	506 E. 48th St., Los Angeles, Cal.	.5
6VZ	Strawn, Harold A.	2919 Pasadena Ave., Los Angeles, Cal.	.5
6OG	Waite, Harold E.	Compton, Cal.	.5
6ALA	Wells, Herbert C.	Oceanside, Cal.	1
6AKA	Whiting, Edmund W.	1047 Mignonette St., Los Angeles, Cal.	1
6WY	Whiting, William	1325 Guerrero St., San Francisco, Cal.	.5
6ADA	Woods, Hubert	1222 Milford St., Glendale, Cal.	.5

SEVENTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
7AK	Arndt, Norman J.	110½ S. 14th St., Tacoma, Wash.	.5
7AH	Dawson, J. Oliver	E. 10th and Lucille Sts., Vancouver, Wash.	.5
7HY	Hicklyn, Harold H.	2909 S. Warner St., Tacoma, Wash.	.5
7EO	O'Brien, Lester E.	Fairfax, Wash.	.5
7AJ	Shatto, Luverne E.	426 15th St., Astoria, Ore.	.5
7DV	Sheard, Harold P.	207 S. 5th St., Bozeman, Mont.	.5

EIGHTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
8JK	Baer, Earle E.	1329 Locust St., Pittsburgh, Pa.	.5
8GD	Brinker, Wm. N.	324 West Newton Ave., Greensburg, Pa.	.5
8AJM	Calvert, Allen	248 Calhoun St., Battle Creek, Mich.	.5
8PO	Carter, David G.	Points Aux Barques, Mich.	.5
8QS	McCaig, Wm. J.	1355 Abbott Rd., Buffalo, No.	1
8JU	McCann, Charles S.	Moraine Park, Dayton, O.	.5
8IV	Fox, John E.	1418 Oak Ave., Cincinnati, O.	.5
8AKV	Gaige, Robert J.	3832 Applegate Ave., Cheviot, O.	.5
8IF	Schellenbach, Donald	204 Elm Ave., Wyoming, O.	.5
8AFW	Seiple, Robert H.	1408 3d Ave., New Brighton, Pa.	1

NINTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
9UG	Blakey, Millard	Auburn, Ill.	.5
9SL	Castleberry, Jewell M.	507 Arch St., Fulton, Ky.	.5
9SM	Engler, Robert J.	2712 Fremont Ave., S. Minneapolis, Minn.	1
9TE	Girol, Earl C.	311 S. Baker St., Winona, Minn.	.5
9UB	Huston, Paul E.	2205 N. New Jersey St., Indianapolis, Ind.	1
9TB	Koresh, George	419 50th Ave., West Allis, Mich.	.5
9TT	Loebe, Roy A.	Orland, Ill.	.5
9SF	Mehrholz, Irvin	2133 Summerdale Ave., Chicago, Ill.	.5
9AJM	Meth, Charles F.	3919 N. 24th St., Omaha, Neb.	.5
9EB	Oakley, Robert N.	725 F St., Salida, Colo.	1
9GQ	Ristau, Harold	1937 Cornelia Ave., Chicago, Ill.	.5
9NL	Schattschneider, Emil G.	2600 Sheridan Rd., Zion City, Ill.	.5
9AC	Spetzman, John	Powers Lake, Wisc.	.5
9TS	Stansbury, Clinton	1701 Summit St., Kansas City, Mo	1

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of August, 1916.

FIRST DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
1CN	Brown, Theodore S.	51 Bigelow St., Quincy, Mass.	.5
1CU	Collins, George A.	269 Willow St., Mansfield, Mass.	.5
1CK	Florence, William E., Jr.	79 Salem St., Reading, Mass.	.5
1GM	Haffcke, Philip M.	47 Locust St., Danvers, Mass.	1
1BJ	Hatch, Harold P.	West Bridgewater, Mass.	.5
1AY	Hill, E. Roland	Noank, Conn.	.5
1VI	Inderelst, Wm.	Mystic, Conn.	.5
1JZ	Drew, Frank E.	31 Soule St., Plympton, Mass.	.5
1AJ	Kilduff, Thomas	32 Wensley St., Roxbury, Mass.	.5
1NK	Kohl, Wm. C.	75 Richardson Rd., Melrose Highlands, Mass.	.5
1BV	Lussier, Elphege A.	1024 Purchase St., New Bedford, Mass.	.5
1BQ	Murdock, C. W. Lewis	185 Church St., New Haven, Conn.	.5
1JP	Parkhurst, Richmond W.	458 Massachusetts Ave., Arlington, Mass.	.5
1CH	Penobscot Bay Wireless Co.	Criehaven, Me.	.5
1AV	Richardson, George D.	R. F. D. No. 4, Westport, Me.	.5
1AB	Shaw, Ronald H.	101 N. Central Ave., Wollaston, Mass.	.5
1CB	Southwick, Harold F.	103 Green St., Fall River, Mass.	.5
1BL	Tripp, Douglas B.	26 Ward St., New Bedford, Mass.	.5

SECOND DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
2ATJ	Falco, Charles	140 Sands St., Brooklyn, N. Y.	.5
2ASY	Greenman, Ralph D.	138 Berkeley Pl., New York, N.Y.	.5
2ASS	Kaufer, Alvert, Jr.	1085 Broadway, Brooklyn, N. Y.	.5
2ASQ	McCabe, Oliver	124 Cornaga Ave., Far Rockaway, N. Y.	.5
2ASV	Moir, Stirling	2007 Foster Ave., Brooklyn, N. Y.	.5
2ASU	Mudgett, Guernsey	698 E. 22d St., Brooklyn, N. Y.	.5
2ASW	Porter, Roland G.	New York, N. Y. (portable station).	.5
2ATH	Ridley, Clarence O.	141 W. 138th St., New York, N. Y.	.5
2ABG	Runyon, Carman R., Jr.	563 Palisade Ave., Yonkers, N. Y.	1
2AST	Sisson, Edgar J., Jr.	214 Valley Rd., Montclair, N. J.	.5
2ATL	Storm, George	745 Highland Ave., Newark, N. J.	.5
2PO	Talone, Frank A.	1504 Federal St., Philadelphia, Pa.	.5
2ASX	Thomas, Russell L.	5 River Rd., Highland Park, N. J.	.5
2ASR	Wibecan, George E.	434 Pulaski St., Brooklyn, N. Y.	.5

THIRD DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
3DS	Alden, Philip M.	334 S. 43d St., Philadelphia, Pa.	.5
3AHL	Apgar, S. Leslie	Lebanon, N. J.	5
3GP	Beard, Ralph W.	206 34th St., Norfolk, Va.	5
3HS	Byam, Hendry S.	768 Haddon Ave., Collingswood, N. J.	.5

THIRD DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
3FU	Gerlach, George M.	200 Maryland Ave., Cambridge, Md.	.5
3AGM	Kopp, Desmond	Solomons, Md.	.5
3AX	Laughman, P. Curtis	119 S. Penn St., York, Pa.	1
3RL	Lowe, Ralph C.	335 W. State St., Media, Pa.	.5
3HV	Mickey, Leroy	2028 S. Croskey St., Philadelphia, Pa.	.5
3AIX	Moyer, John A.	55 Hillside Ave., Madison, N. J.	.5
3AIK	Paine, Harry S.	222 S. 8th St., Lebanon, Pa.	.5
3AHG	Sprecher, S. Roy	R. F. D. No. 5, Lancaster, Pa.	.5
3AIZ	Sutton, Berton K.	Lebanon, N. J.	.5

FOURTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
4BB	Derby, Horace	41 W. Boulevard Drive, Kirkwood, Ga.	.5
4AV	Hurlebaus, Edward H.	439 Main St., Bradentown, Fla.	.5
4BX	Kramer, Kermit	308W. Main St., Elizabeth City, N.C.	.5
4CV	Lee, Theodore A.	36 N. Mayson Ave., Atlanta, Ga.	.5
4EH	Sheib, Samuel H.	Semora, N. C.	1
4EG	Trammell, George W., Jr.	509 E. 1st St., Rome, Ga.	.5
4BE	Woods, Dqn E.	Jackson, Ga.	.5

FIFTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
5BD	Simonds, Ernest A.	6045 Patton St., New Orleans, La.	.5
5AW	Stone, Frank M.	7919 Jeannette St., New Orleans, La.	.5
5BR	Vaccaro, Whoner	814 Washington Ave., Memphis, Tenn.	1
5AJ	Watkins, Wm. O.	203 1st Ave., Birmingham, Ala.	.5

SIXTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
6ACA	Andrews, Clarence A.	Ontario, Cal.	.5
6AGB	Bockman, George H.	430 Masonic Ave., San Francisco, Cal.	.5
6AAE	Bray, Harold R.	Oceanside, Cal.	.5
6JF	Brown, Sedric R.	Oceanside, Cal.	.5
6DF	Buckner, Harold E.	Morgan Hill, Cal.	.5
6HC	Chaplin, Charles W.	1187 E. 5th Ave., Pomona, Cal.	.5
6UX	Coover, W. Rad	1613 19th St., Sacramento, Cal.	1
6ALD	Dye, Leland E.	8718 Compton Ave., Graham Station, Cal.	1
6VX	Francisco, Wallace	538 37th St., Oakland, Cal.	1
6IZ	Harrison, Irvin	1021 N. 9th St., Phoenix, Ariz.	.5
6PA	Heling, Earl E.	1807 6th St., Eureka, Cal.	1
6HF	Heller, Bertram O.	1133 W. 41st Pl., Los Angeles, Cal.	1
6JK	Killgore, Jason S.	1607 Vine St., Glendale, Cal.	.5
6BM	McNamee, Bernard F.	925 Franklin St., San Francisco, Cal.	.5

(To be Continued)

ELECTRICITY AND LIFE.

(*Continued from page 798*)

Some years ago the great Swedish scientist, Arrhenius, was reported to have subjected one-half of a class of school children to the action of high-frequency currents, one hour daily for several months, at the end of which time there was marked increase in the average growth, weight, general health and mental ability in the electrified pupils as compared with those not so treated. At the present time high-frequency currents are actually being used in truck-gardens to promote the growth and increase the size of vegetables for table use.

The high-frequency currents, in short, act as *vitality boosters*—no other form of electricity will do this. *Galvanism, Faradism, Static* electricity are all valuable agents in the hands of the Electro-therapeutic specialist, but they have little direct action in promoting cell vitality and growth, as do the high-frequency currents when properly applied.

Authorities explain the action of high-frequency currents in various ways, the favorite theory being that the healing effect is due solely to the liberation of heat in the tissues. It is perfectly true that in many diseases the heat liberated in the body by the passage of from 400 to 2,500 milliamperes at a frequency of about one million cycles is an important agent in promoting an artificial inflammatory reaction and increasing circulation. The heat is, however, only one of the *secondary* forces generated by the current; there are many other factors in the vitalizing effect. The thermic theory will, for example, not explain the increased growth of plants produced by the action of high-frequency currents of very high voltage and low amperage. In medical practise often the most marked results are obtained by the use of Tesla currents of low intensity, but of exceedingly high potentiality. The author can account for these effects only on the theory that these currents, when of proper frequency, are *synchronous with the normal rate of sympathetic nerve vibration,* and in this way increase the flow of the mysterious *Pranic* force thru which function and tissue growth are maintained.

High-frequency currents are now extensively used by the medical profession to increase cell growth, metabolism and functional activity. They tend to normalize the blood pressure and are the only agents that are of real curative value in certain stages of Arterio-sclerosis (hardening of the arteries). They greatly augment the defensive powers of the organism, enabling it to resist and overcome disease-producing agencies. The prejudice against high-frequency currents on the part of many physicians may be attributed to the fact that they do not employ proper technique or that they use an apparatus which does not admit of proper variation of frequency, amperage and voltage, in order to suit the requirements of the individual case.

In the next article the author will describe the details of construction of an apparatus suitable for the generation of high-frequency currents for therapeutic use and the technique for their application.

AN ELECTRIC "MOVIE" MACHINE FOR THE HOME.

(*Continued from page 795*)

The mother may catch on the film the first steps of the toddling baby; the boy can snap his mates at play; the family can have their birthday motion pictures of every member, not to mention the Thanksgiving and Christmas reunions.

The adoption of this instrument to the study of various subjects will be of immeasurable value, especially in geography, biology, chemistry and physics, which will certainly be simplified by the use of this invention. The new device may be used with equal advantage for projecting visualized bulletins for public use. It is without doubt one of the greatest inventions in the motion picture field and will certainly solve many dubious problems.

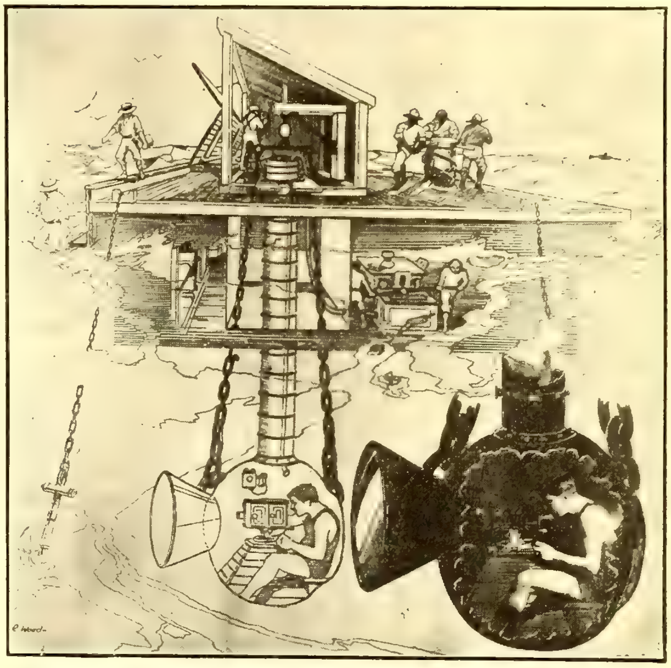
20,000 LEAGUES UNDER THE SEA.

(*Continued from page 791*)

fore, it is also fitted with a torpedo, which is later actually discharged at one of Capt. Nemo's enemies.

Our second photograph illustrates the submarine's sea drop-door open, one of the sailors emerging under the water. The crew, when starting on its undersea journey, is equipt with the necessary diving apparatus, these being self-contained and employing no lines or pipes with which to supply fresh air. On the back of the sailors are strapt comprest air tanks and these are carried about without undue trouble. The divers' feet are covered with shoes having heavy leaden soles so as to increase the body weight, permitting the operator to walk on the bottom of the sea.

We see several wonderful actual scenes at the bottom of the ocean and one of our illustrations shows a photograph of the crew of the *Nautilus* walking on the sea bottom entirely free from any encumbering connections whatsoever. One of the sailors can be seen holding a sea turtle which he is carrying in his hand, clearly shown in our illustration.



Illustrating the Novel Manner in which Scenes for the "20,000 Leagues Under the Sea" Movie Spectacle Were Photographed by Placing the Camera and Operator (In Swimming Suit) Down in a Special Tube.

Considerable difficulties are encountered in walking on the ocean bottom, due first to the tremendous water pressure and second to swift currents along various points. Many interesting underwater performances are given by Capt. Nemo and his crew; the scenes showing actual man-eating sharks and hunting them, is perhaps one of the most thrilling pictures ever made. There is no faking in these pictures and in one of them can be actually seen how one of the sharks makes a vicious slash at Capt. Nemo, only to be rebuffed with the butt of his rifle. Another fascinating scene is that showing a battle with an octopus with Capt. Nemo, but this scene was obviously staged with a dummy octopus. Another scientific feature shown, which, by the way, was predicted by Jules Verne, is the employment of comprest air guns which are quite necessary for the undersea hunts.

What the audience of course does not see is how these pictures were taken. It involved the use of wonderful electrical equipment in producing this most remarkable film. To begin with, a special camera had to be employed. This was enclosed in wide tubes fitted with powerful lenses at the lower end. Into this tube was placed a regular photographic motion picture camera as well as the person operating it. While many of the pictures were taken in actual sunlight (the sun shining directly thru the water and giving sufficient illumination, providing the depth was not too great), most pictures were taken at such a depth that electrical illumination was necessary. This was accomplisht by projecting powerful beams from electrical searchlights on the scenes to be filmed. The electrical energy supplying these monstrous electric arcs was fed thru heavy submarine cables and attached to dynamos driven by gasoline engines, supported on barges near the scene of this Twentieth Century Capt. Nemo's exploits.

As an educational film, "20,000 Leagues Under the Sea" probably rivals anything that has appeared heretofore.

It is a great pity that Jules Verne, who died some eight years ago, could not have lived to see this wonderful picture, which so well demonstrated his vast knowledge in all the various branches of science.

Photos Courtesy of Universal Film Company

FUR COAT "ELECTRICITY" BLOWS UP AUTO.

Electricity induced by the friction of a fur coat worn by Surgeon Raymond Spear, U.S.N., grounded thru an automobile standing on wet ground and caused a spark which exploded the gasoline, burning Surgeon Spear severely and destroying the machine. The surgeon was able to leave the naval hospital here, but still is under treatment at his home.

Surgeon Spear had walked some distance to his garage in his fur coat and rubber boots. The friction of the flapping of the coat against his legs generated the electricity, while his boots insulated him from the ground and allowed his body to store it. A spark did the rest.

CELEBRATING MR. EDISON'S BIRTHDAY.

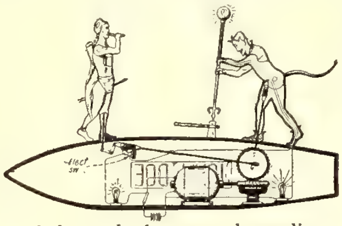
The employes and associates of Mr. Thomas A. Edison celebrated his seventieth birthday at a dinner held in the electric storage battery building, West Orange, N.J., at 6:30 p. m., Saturday, February 10. The event was informal and entirely social, and about 1,500 persons were present. Some of Mr. Edison's personal friends and former associates were invited. Mr. Edison's birthday is really on February 11, but on account of that day falling on Sunday, it was decided to hold the celebration on Saturday the tenth.

LATEST PATENTS

Advertising Novelty

(No. 1,207,945; issued to John Jay Lepper.)

A unique electrical advertising attraction comprising a transparent cigar-shaped body; upon this are mounted a figure (Indian) holding a cigar and a figure representing Satan. An electric motor within the base drives a worm wheel, which latter causes the Satan figure to

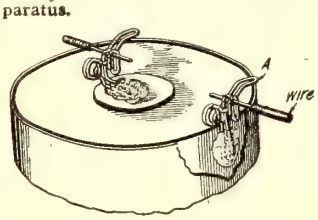


bend forward, the spear descending and the lamp atop it lighting up, as well as the lamps within the transparent base. The mechanism also causes the Indian to place the small cigar in proximity to his mouth. The electric current may be supplied from battery or lighting circuit. The name of dealer can be placed on side of transparent base, being thus periodically illuminated.

Electrical Connector

(No. 1,209,604; issued to Hosea F. Maxim.)

An extremely simple and cheaply manufactured form of electrical connector, suitable for attachment to dry cells and other electrical apparatus.



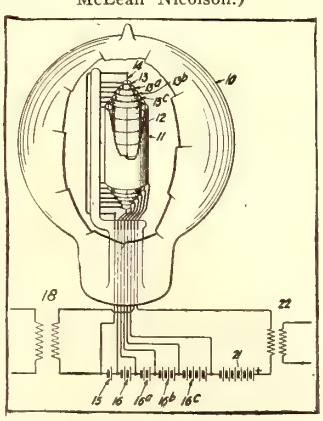
It combines, in its design, extreme simplicity, being formed from a single piece of springy wire, which requires no other operations but that of bending.

The connector may be soldered to dry cell electrodes and the conductor is secured therein by pressing down on the extending finger, A.

A number of novel modifications in the design of this connector are given in the patent. The connector is to be made of some springy wire, such as phosphor bronze, brass or steel.

Thermionic Amplifier

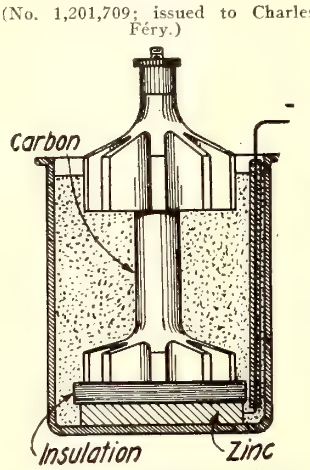
(No. 1,210,678; issued to Alexander McLean Nicolson.)



In the figure, 10 represents a highly evacuated vessel; 11 an anode; 12 an input electrode; 13 equipotential cathode; 14 auxiliary cathode or filament. Cathode 14 of platinum, coated with oxids, and heated by battery 15 emits electrons, which bombard cathode 13, maintained positive by battery 16. Cathode 13 is made thermionically active also. A number of equipotential cathodes can thus be used, having successively increasing electron-emitting properties. Each of the cathodes 13, 13a, 13b, and 13c, receives a bombardment; batteries 16, 16a, 16b and 16c maintaining each succeeding cathode positive with respect to the preceding cathode.

Improved Primary Cell

(No. 1,201,709; issued to Charles Féry.)



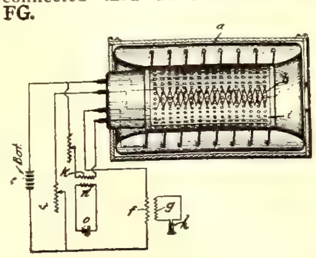
Over the zinc is placed a sheet of insulation such as felt, or hard rubber, etc. On this insulation rests the carbon element as shown. By thus keeping the zinc at the bottom of the jar the ammonium gas can be liberated freely and without encountering the chlorid of zinc, with which it combines in the ordinary cell of this type, to form crystals which mitigate against the efficiency of the battery.

The cell rapidly depolarizes due to the considerable electric currents which are generated between the top and the bottom of the carbon electrode.

Relay for Undulatory Current

(No. 1,212,163; issued to Eric Magnus Campbell Tigerstedt.)

An improved relay for undulatory currents which may be actuated by a microphone O, and the effect noted in a telephone receiver H, connected thru an induction coil FG.



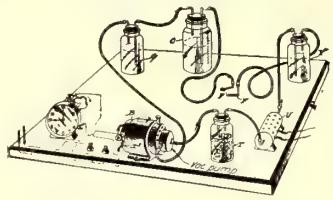
The relay comprises a soft iron cylinder, containing an evacuated chamber A. Therein reposes a cathode B, in the form of a helically wound wire, supplied with battery current so as to become heated. A helical anode is placed over the perforated grate-shaped auxiliary electrode, I.

By this design, the ionizing rays, owing to their radial movements, will be the least affected by external magnetic and electrical influences.

The current variations in the primary winding N, graduated by microphone O, are transmitted to the secondary K, and auxiliary electrode I, so that the resistance between the latter and the cathode is thereby altered. This changes the resistance of the discharging tube, which causes the microphone fluctuations to be transmitted to the primary F, of the telephone receiver circuit and, eventually, to the receiver H.

Surgical Cleansing Apparatus

(No. 1,209,846; issued to Charles Edmund Kells.)



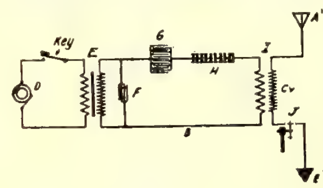
In this electrical surgical cleansing and medicating apparatus, an electric motor drives a vacuum pump, the motor being operated at certain periodical, definite intervals.

An electric heater U, is placed in the tube thru which the medicating or relief vapors pass; T, being a filter; O, the catch receptacle for pus or other fluids brought from the wound, and Q is the wash jar. V is the ether jar and FF, the tips to be placed in the wound.

High Frequency Radio Circuit

(No. 1,211,863; issued to David G. McCaa.)

This arrangement is adapted to radio-telegraphy and radio-telephony. A larger condenser, having about fifteen times the capacity of the one across the secondary, is con-

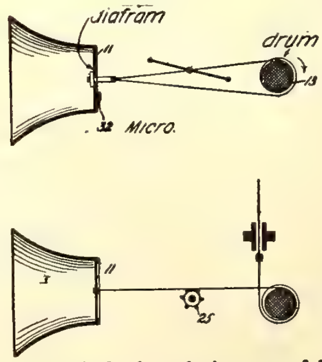


nected in series with the spark gaps and the primary of an air-core transformer.

This method consists in electrically energizing an oscillatory circuit, charging the opposite poles of the condenser F, by conduction, simultaneously charging the opposite poles of large condenser G, by conduction and induction, discharging said condenser G, across the multiple spark H, and controlling such condenser discharge at the gap.

Apparatus for Producing Vibratory Motion

(No. 1,207,387; issued to Reginald A. Fessenden.)

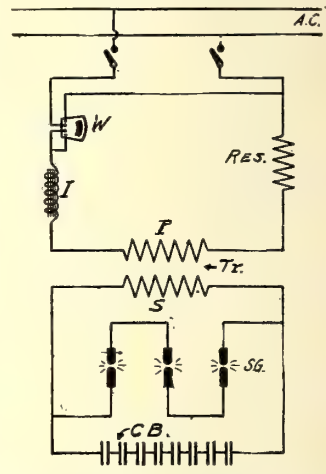


A method of producing powerful sound waves or vibrations by causing a steel ribbon or wire to oscillate a diafram; the steel ribbon, taking a turn about a phosphor bronze wheel or drum.

When the phosphor bronze wheel is rotated so as to render one end of the steel band tight and the other end loose, the wheel acts as a rotating snubbing block and pulls the diafram in a certain direction, which causes the opposite end of the steel wire or band to slacken to such an extent, that the turns on the wheel 13 slip, causing the diafram to return to its normal position; after which the operation is again repeated.

Ultra-Violet Ray Generator

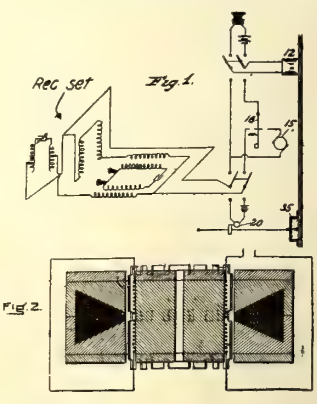
(No. 1,207,347; issued to Joseph Von Kowalski-Wierusz.)



A source of alternating current supplies a step-up transformer, the secondary circuit of the step-up resonance transformer containing the special arcs SG, and condensation battery CB, of the proper size.

Apparatus for Submarine Signaling

(No. 1,207,388; issued to Reginald A. Fessenden.)



Energy from an alternating current dynamo 15 passes into an electro-magnetic sound producing mechanism (vibrator) 12, Fig. 2.

A key 16, may break up the powerful sounds produced by 12, mounted on the steel hull of a ship so as to radiate telegraphic dots and dashes. The sound waves striking the hull of the vessel from a distant station may be interpreted thru the same mechanism 12, or thru a vibrating reed and microphone, 20-35.

A microphone and source of current may be used to excite oscillator 12, when sending telephone speech thru water.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH

Phoney Patents

Under this heading are publisht electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

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PHONEY PATENT OFFIZZ

S. M. ARTALEK of KOKOBUST, O.

AUTO PARASITE

No. $\sqrt{\frac{\text{E.M.F.}}{\text{S.O.S.}\frac{1}{4}}}$

Spessification of Patent Bettors **Patent Magnified**

TO HUME IT RIGHT CONSERVES:—

Let it be known to all in and out habitants of the Universe and Uniprose, as well as to all subjects of possessions and territories, not admitted to Planetdom, that I, S. M. Artalek of the City of Kokobust in the State of Complete Ossification, have conceived, devised, invented and finally thunk out an exceedingly efficient as well as profissient means of Flivver-propulsion, which to the best of my knowledge and widespread researches has not appeared before in print anywhere in the Universe.

Inasmuch as gasoline prices have been rising skyward with such alarming regularity of late, it has become a manifest impossibility for ordinary cattle to run about in Runabouts or Runaflivvers. Altho enterprising garages are now giving away a completely equipt flivver with every five-gallon can of gasolene, the owners have no further use for the car, after the original supply of gas gives out, as a second mortgage on the house and cow will not bring sufficient cush to buy enough gas to prime a spark plug. Realizing this lamenting state of affairs, I have devised a very simple apparatus which can be installed at low cost on any flivver, completely and successfully taking the place of gasoline. Once installed, this device—which I term Auto-Parasite, because it lives on wealthy men's cars—not only will work at no cost to its owner, but it will actually charge his storage battery free of charge as well.

Referring to my drawing A is a dynamo drove by the hindmost axle of the flivver. As soon as the hindmost wheels rotate, the dynamo by virtue of its inherited powers begins to charge without charge the storage battery B. From this latter aforementioned and thusly described battery B, two electric conductor insulated wires lead to a double electromagnet C of generous and stoutish proportions as will be observed and seen by looking at the aforementioned above previously pointed out drawing forming part of this patent spessfication.

Now then, the electromagnet C aforementioned above and described thereunder is mounted at the bow-most end of a movable X:X:X:X:X as best seen and visualized as well as observed in aforementioned described drawing.

At the stern-most end at the starboard side of the movable X:X:X:X:X also aforementioned and duly described, a lever arrangement D with a handle is organized, planted and otherwise attached to suit the erstwhile fancy of aforementioned flivver owner described and pointed out above. By moving aforementioned lever D forward at the critical moment, the aforementioned electromagnet C is energized most powerfully and simultaneously shoots out on the *now extended* aforementioned X: :X: :X. Inasmuch as most car bodies are of sheet tin, the electromagnet will experience a strong affinity for the car ahead and consequently will hang on with bulldog tenacity, incidentally pulling along the flivver, owner, all aforementioned above, at least as long until the wealthy guy ahead gets wise. In that case a new victim must be secured.

WHAT I CLAIM IS:

1° A gasless, costless, juiceless flivver attachment.

2° An autoparasitic attachment prying upon the body of rich men's cars.

3° An automatic gratis-working auto-puller for the masses.

In memoriam whereof, I have thus herebefore imprest in hard wax, seal in hand, my pussyfooted phizt this 19th day of our Ford, 1917, ⅛ of 12 O'Clock Moon, with 63° humidity on the 78 meridian due East.

S. M. Artalek,

By His Attorney,

JAMES McLAUGHLIN MONO,

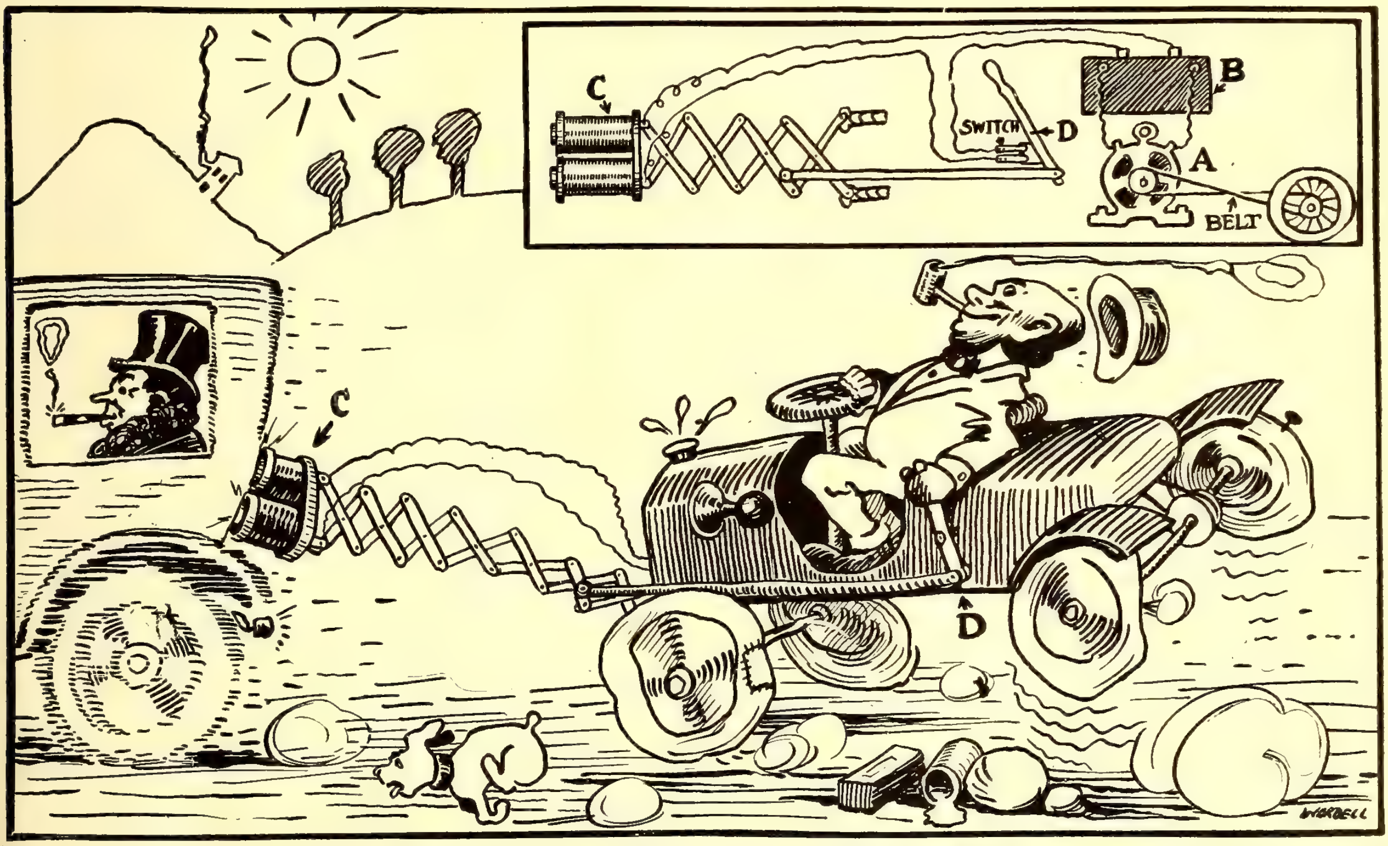
Fair Haven, N.J.

WITNESSES

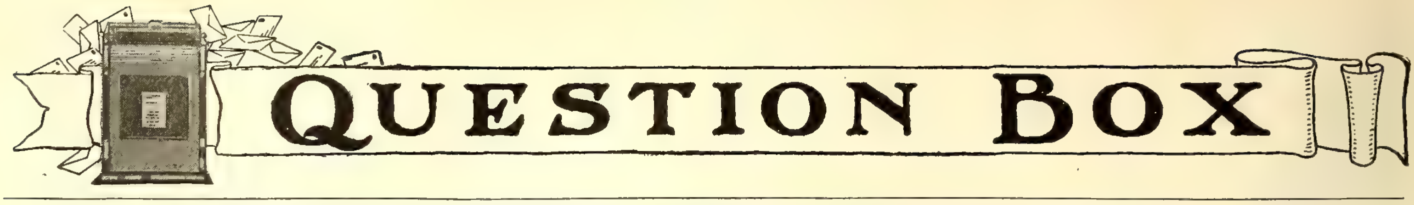
C. Laret

Al. Kohol,

W. H. Yskey.



" . . . I Have Devised a Very Simple Electro-magnetic Auto Propulsion Apparatus, which can be Installed at Low Cost on Any Flivver . . . Once Installed, This Device—the 'Auto-parasite'—Not Only Will Work At No Cost to Its Owner, but Will Actually Charge His Storage Battery Free of Charge."



This department is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

RESISTANCE OF RHEOSTAT.

(712-A.) F. Eilman, St. Louis, Mo., asks:

Q. 1. How is the resistance of a rheostat varied?

A. 1. The conductors are generally all in series and connections are made at various points with contact buttons, upon which a moving arm sweeps, so as to include more or less of the resistance. Sometimes the resistance is reduced while the carrying capacity is increased by putting more or less resistance units in multiple, as when a bank of incandescent lamps is used for regulating a current. Combinations of the two are made occasionally, the highest resistance being given by connecting the units in series while the resistance is reduced by cutting out one section after another, the resistance being still further reduced by putting units in multiple.

Q. 2. What is the difference between a pole-changer and a pole-changing transmitter?

A. 2. The construction of a pole-changer is such that the circuit is momentarily broken at each reversal, whereas in the pole-changing transmitter, continuity of the circuit is preserved.

Q. 3. What is accomplisht by the use of relays on telegraph lines?

A. 3. They reduce considerably the battery current required and the size of conductors used. The relays operate on a small fraction of an ampere while telegraph sounders require a fairly large current in amperes. The relay for main line work is usually of 150 ohms resistance; short line relays have 20 ohms resistance, and specially wound sounders of 20 ohms resistance are sometimes used. Relays are of more delicate construction and consequently more sensitive than sounders, which latter utilize a heavy sounding bar. The sound given off by a relay armature is often intensified by fitting a resonator or diafram horn to it, as described some time ago in this journal.

X-RAY QUERIES.

(712.) Paul Higgins, Charleston, S.C., wishes to know:

Q. 1. How are X-rays produced?

A. 1. If an electrical discharge be passed thru a vacuum tube, X-rays are produced whenever the cathodic stream is arrested by the walls of the tube or metallic objects therein.

Q. 2. What is a focus tube and for what kind of work is it most applicable?

A. 2. A focus tube is one in which a concave cathode electrode causes the stream of electrons to be focused upon a flat target or anode. They are generally used for obtaining a rapid radiograph of finite, concentrated area.

Q. 3. What is the composition of chemicals employed in the manufacture of fluorescent screens?

A. 3. They are generally composed of platinum-barium-cyanid, while the cheaper variety are made with phosphorescent calcium sulfid.

BELL CIRCUIT.

(713.) I. Simpson, Ottawa, Canada, inquires:

Q. 1. What precaution should be taken with a bell when continuously operated?

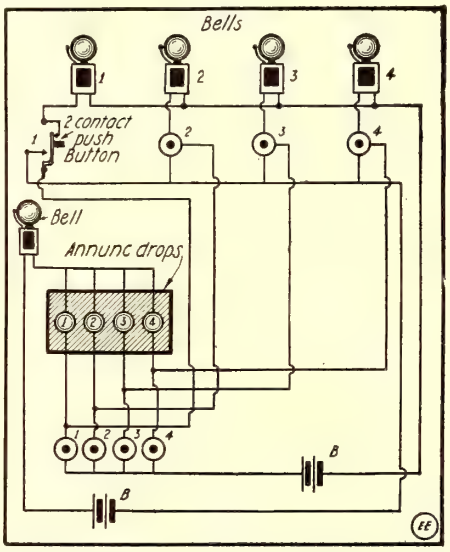
A. 1. The contacts should be cleaned regularly and also adjusted as required.

Q. 2. Can you give me a wiring diagram of a 4 bell and 4 drop annunciator for a fire alarm?

A. 2. The diagram herewith gives the proper connections.

Q. 3. What is the appearance of an arc when observed thru a smoked glass?

A. 3. The current (or rather the incandescent carbon particles) is plainly seen passing from the positive to the negative carbon.



Wiring Diagram for Four Room Bells and Four Drop Annunciator, so that Clerk Can Ring Guests' Bells In Case of Fire.

PUPINIZATION.

(714.) W. Wilson, Pittsburgh, Pa., asks:

Q. 1. What is meant by Pupinization?

A. 1. The word is derived from Professor M. I. Pupin, of Columbia University, who introduced the first successful method of loading telephone cables and aerial lines. The inductance coils are built in ring form and each has a definite value, depending upon the characteristics of the line and its location.

When working with telephone cables, certain obstacles are to be overcome, such as inductance, capacity, resistance and leakance. Capacity troubles telephone engineers most, and this was compensated for by adding inductance to the line. Special care is exercised in designing inductance (loading) coils, and Professor Pupin was the one who developed mathematical proofs and design data of loaded telephone cables.

The attenuation of cables is very important; it is wise to keep this as low as possible. The American Telephone and Telegraph Company consider 3.66 for the attenuation constant of a cable. This constant is obtained from a large expression. However, this was reduced to a simpler one:

$$B=\sqrt{\pi f C R}$$

Where:

B=attenuation constant for the cable.
f=frequency.
C=capacity.
R=resistance.

It was Pupin who formulated the different values of B. We would especially refer you to THE ELECTRICAL EXPERIMENTER for August, 1916, page 274—"Question Box."

Q. 2. In what unit is leakance exprest?

A. 2. This term has not as yet been empirically nomenclatured, but it is exprest as the reciprocal of insulation resistance, which is in megohms and is called mohoms. It is very small in aerial telephonic lines and quite large in underground cables.

HIGH FREQUENCY RESISTANCE.

(715.) John Olsen, Hempstead, L.I., inquires:

Q. 1. Is the direct current resistance of a conductor equal to that offered by the same conductor, when said wire is excited by means of an oscillatory high frequency current?

A. 1. The high frequency resistance of a conductor, when it is excited, is not the same as its D.C. resistance, but is several times as great as its D.C. resistance. The following expression is used for calculating the high frequency conductor size:

The high frequency resistance of the conductor is:

$$R^1=R\frac{\pi d}{80}\sqrt{N}$$

Where:

R^1=high frequency resistance of the conductor.
d=diameter of conductor in centimeters.
R=direct current resistance of conductor.
N=frequency of the oscillatory current passing thru the wire.

The formula below applies only to solid, nearly straight or slightly curved, circular-sectioned copper wires.

Where:

$$d=.4774\sqrt{\frac{P}{N}}$$

d=dia. wire in cms. for high frequency current.
P=resistivity of the conductor (=1600 for copper).
N=frequency.

Q. 2. Does the Cohen circuit of capacity tuning prove more efficient than the straight inductance tuning?

A. 2. The capacity tuning of the Cohen circuit is more selective than the straight inductance system, but it has been found that it is not particularly efficient when it is used on wave lengths above 2,500 meters, and on long distance work.

Q. 3. Does it effect any improvement to employ several arcs for radiophone work and are they better than a single arc?

A. 3. Several arcs are better than a single arc, as considerably more current is generated with a multiple arc system. The

(Continued on page 836)

READ THESE LETTERS

HERE IT IS—AND HERE IS WHAT IT DOES

"PARAGON" RA-6 Amplifying Short Wave Receiver.
Range 180-580 meters. Price $35.00.
"It Has Solved the Transcontinental Relay Problem"

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A PRODUCT MAY BE JUDGED BY ITS USERS!

"The results obtained have been almost marvelous."
(2LK) J. O. Smith, Valley Stream, N. Y.

"In a word, I think it is the greatest short wave tuner I ever saw."
(8JZ) Rev. A. J. Manning, Cleveland, O.

"I take this time to congratulate you on the design of the perfect short-wave receiver. I have never seen anything in its class before."
(2FS) Howard L. Stanley, Babylon, N. Y.

"I am delighted with the results."
(2AFT) Folger Oudin, Schenectady, N. Y.

"I like the RA-6 very much."
(1ZM) Hiram Percy Maxim, Hartford, Conn.

"The results obtained with it have surprised me very much. Using it I worked 2AGJ at Albany for about an hour, and not once did he fade out so I could not get him back. At times I could hear him several feet from the 'fones. Other stations hitherto just readable come in very loud."
(9IK) R. H. G. Mathews, Chicago, Ill.

"Results entirely satisfactory. Atmospheric conditions not at all good. Notwithstanding this, however, with two sets of 'fones in series, we could hear and copy many long distance stations including 5DU, 5AM, 8AEZ and 9BY as well as several others we did not mark down."
John C. Cooper, Jr., Jacksonville, Fla.

"'The Set' received several days ago. I want to say it is a peach, and even surpassed my expectations. It is a wonder for selectivity, and all signals very much louder. Have heard stations that I had never heard before, and worked 1VN at noon. You may remember that Hartford has always been closed to us around here."
(2AGJ) John K. Hewitt, Jr., Albany, N. Y.

"Never dreamed that the possibilities of this type of apparatus were so great until I installed instrument."
Wm. H. Allison, Worcester, Mass.

"The finest set for amateurs I have ever tried out. Just as you represented it to me. Have been able to hear some 5s, some 4s, and any number of 1, 2, 3, 8, and 9 stations every night, no matter what the air conditions."
(2ZP) John W. Hubbard, Port Chester, N. Y.

"Have used the RA-6 for about a week with such marked results, that thought a word of appreciation at this time might be of interest to you."
(2IM) L. Spangenberg, Lakeview, N. J.

"The increase in intensity of signals received is almost beyond belief, and I have astonished many of my friends, as well as myself. The set is the most selective I have ever handled, and when familiar with it wonders may be performed."
(2ABG) C. R. Runyon, Jr., Yonkers, N. Y.

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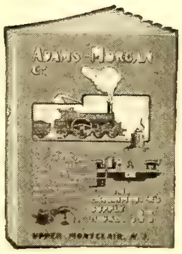

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THE BEST CATALOG OF ITS KIND IN AMERICA

Adams-Morgan Co., 13 Alvin Place Upper Montclair, N. J.

QUESTION BOX.

(*Continued from page 834*)

only difficulty encountered in operating a multiple arc is in properly adjusting them for an oscillating condition.

MAGNETIC ORE SEPARATOR.

(716.) P. Pierpont, Hoboken, N.J., wants to know:

Q. 1. How does Edison concentrate iron ore magnetically?

A. 1. The ore treated is a magnetic ore of iron held in about three times its weight of easily crushed rock. This is crushed between rollers and then allowed to fall in a thin sheet in front of a series of magnets, which deflect the iron particles, but allow the iron magnetic rock to fall vertically. A thin, knife-edged partition board separates the two falling streams. The attracted particles are dried and ground and then separated again from the rock material, then treated chemically and again separated.

Q. 2. How is the attraction of unlike poles and the repulsion of like poles explained?

A. 2. There is no complete explanation agreed upon, altho all the actions can be referred to simple laws. There is tension along the lines of force and a pressure at right angles to them.

SELENIUM CELLS.

(717.) Frank Heeney, Portland, Ore., asks:—

Q. 1. How are selenium cells made?

A. 1. The subject on the construction of selenium cells is quite extensive, and limited space forbids us to publish here complete details on their construction. We refer you to the November 1915 and September 1916 issues of The Electrical Experimenter in which you will find a complete exposition of the construction of selenium cells. If you have not these copies available, we can furnish them postpaid at fifteen cents each.

Q. 2. Is it practical to employ such cells in the construction of a talking moving picture machine?

A. 2. As far as we are informed, tests on such devices have been fairly successful, but we have not heard much lately regarding the further development of such apparatus. The subject is a very interesting one and there is, we believe, a possibility of such a device being developed for commercial use. So far as we know there has been but one extensive article ever publisht on the use of selenium in talking motion pictures, which appeared in the June, 1915, issue of The Electrical Experimenter, which we can supply you for twenty-five cents, if you have not this issue on hand.

Q. 3. Will you kindly inform me as to the originator of selenium cells in talking motion pictures.

A. 3. This dates back to 1904 when Ernest Ruhmer, the German physicist, developed a workable model of such a machine.

USING LARGE SPARK COIL FOR WIRELESS.

(718.) C. Murray, Winnipeg, Man., Canada, asks several questions regarding a 12-inch spark, specially built induction coil.

A. 1. We believe that you use a primary condenser much too large; i.e., made up of 7—2 mfd. condensers connected in parallel. Your spark coil appears to be heavy enough to qualify as an open core A.C. transformer, and you should be able to satisfactorily operate it from the usual A.C. circuit, with a suitable rheostat; or, better an adjustable iron core impedance in series with it to control the current. It also should work very well with an electrolytic

(*Continued on opposite page*)

THUNDERSTORMS OF THE UNITED STATES.

A thoro study of the distribution of thunderstorms has been made by Mr. W. H. Alexander with the aid of the officials in charge of more than one hundred of the regular weather bureau stations. Following this, Professor R. DeC. Ward has fittingly brought out the significance of the thunderstorm as a climatic phenomenon, says *Science*.

Thunderstorms are produced (1) by the excessive heating of the lower air; (2) by the over- and under-running of winds of different temperatures, which in some way cause moist air masses to rise rapidly; and (3) by the cooling of the upper air. These causes usually are not individually responsible for any thunderstorm; but act in conjunction. Excessive heating of the lower air occurs in summer and most favorably on plains, plateaus and intermont basins.

Thus in the United States the maximum number of thunderstorms is to be expected in the Mississippi Valley, and in the western mountain and plateau region. Furthermore, most come in summer: in 126 of 139 stations considered the month with most thunderstorms is June, July or August. Cyclonic activity in a region subject to marked temperature changes is usually responsible for the production of thunderstorms by over-running and under-running winds. This leads to the winter and spring thunderstorms; particularly in the southern Mississippi Valley where the lower air is warmest and dampest. The cooling of the upper air while the lower remains relatively warm is characteristic of a marine location. With the aid of cyclones, thunderstorms produced in this way are to be expected in winter and at night. The Pacific coast region thus tends to have its thunderstorms, few at most, in winter.

For illustration, the accompanying table shows the monthly percentage frequencies of days with thunderstorms at seven stations in the United States. A thunderstorm day is now defined as one on which thunder is heard whether or not rain falls at the observing station.

Station	Per Cents. of Ten-year Total Occuring in Each Month												Total Thunderstorms, 1904-1913
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
San Francisco, Cal.	12	50	12	0	0	0	0	0	0	12	0	13	8
Fresno, Cal.	3	14	16	14	16	5	3	0	11	8	5	5	37
Boston, Mass.	2	1	4	4	14	17	23	22	11	2	2	1	180
New York, N. Y.	1	1	3	9	14	18	25	19	9	3	0	0	284
Chicago, Ill.	2	1	6	8	15	16	17	16	12	4	2	0	400
Santa Fé, N. Mex.	0	1	3	4	9	15	29	24	12	3	0	0	732
Tampa, Fla.	1	2	3	3	10	17	24	22	14	3	0	1	944

At San Francisco, atmospheric instability does not often occur in summer. Fresno has its maximum early probably because the air is too dry in mid-summer. The other stations have the greatest number in summer. Boston, New York and Chicago all have an abundance of moisture. The greater number of thunderstorms in Chicago for the year, and particularly in spring, as compared with New York and Boston, is due to its continental position and exposure to rapid temperature changes. The interior location favors more rapid warming in spring than is the case in the east. Even New York appears markedly more continental than Boston. It is noteworthy that there are more thunderstorms in May than in September; May is moister; and the upper air is colder. The great thunderstorm activity at Santa Fé is favored by the mountain location (altitude 7,013 feet) east of the Rio Grande. In June, July and

(*Continued on page 840*)

QUESTION BOX.

(*Continued from page 836*)

interrupter and a choke coil in series to regulate the current. When it is used in this way on 110 volt A.C. circuit, a kick-back preventer of an approved pattern, should be connected directly across the primary terminals of the coil and thoroly grounded.

This coil should give you good results for wireless purposes and we should imagine that it would give you in the neighborhood of $\frac{1}{2}$ to $\frac{3}{4}$ k.w. depending upon the regulation of the current in the primary circuit. You will find a great deal of valuable information in this direction in our excellent twenty-five cent handbook entitled "How to Make Wireless Sending Apparatus."

BOOK QUERY.

(719.) The T— M— Co., Muscatine, Iowa, asks for information on books:

A. 1. We refer you to our *Book Catalog* in which you will find a number of excellent books listed on high frequency apparatus, induction coils, etc.

We can supply a copy of the book entitled "The Design and Construction of Induction Coils" by A. F. Collins at $3.15 prepaid. We can also supply you with the book "Induction Coils, Their Theory, Design and Construction," by H. Armagnat for $2.10 prepaid. An excellent work on Liquid Air by Sloane, which covers the making of snowballs, etc., artificially, is worth $2.00.

LOCATING BURIED GOLD AND SILVER DEPOSITS.

(720.) Geo. H. Gibson, St. Louis, Mo., writes:

Q. 1. Can you advise me of an electrical apparatus that will accurately locate gold and silver deposits in the ground?

A. 1. We do not know of any device which will intercept and interpret or make manifest the extremely minute electrical radiations, if such they are, sent out by the vibrations of the atoms in chemicals such as gold or silver buried in the ground.

Some success has been claimed in locating such metallic deposits if they are not buried too deeply with the Hughes' induction balance, which was described on page 260 of the August, 1916, issue of THE ELECTRICAL EXPERIMENTER, a copy of which can be obtained at 15 cents.

RADIATION FROM WIRELESS STATION.

(721.) L. A. G., Los Angeles, Cal., writes us concerning his radio station and the theoretical efficiency of the same as computed by the usual formulae.

A. 1. The reasoning and formulae as set forth in Mr. Whitney's article in the November, 1916, issue of THE ELECTRICAL EXPERIMENTER, are correct. There was a small discrepancy made in carrying out the computations incident to working the formula as mentioned on page 671, December issue, but the formula itself and the terms therein are correct.

You will find this method explained in all of the radio handbooks, including those by Dr. J. A. Fleming and Dr. Eccles.

The editor of this column has had some experience with this radiation current formula and the terms therein vary of course for different designs of aerial. It is found that for your case, and considering the natural or fundamental wave length of your inverted "L" antenna squared as 5,700,000, the radiation in watts would be 24.8 and the net efficiency of the station 24.8 divided by 1,350 watts input or 1.84 net efficiency, which is nearly 2 per cent.

The different quantities here involved are not very explicitly stated in your letter and the low efficiency in either case might be

(*Continued on page 840*)

QUESTION BOX.

(*Continued from page 837*)

due, we believe, to the fact that the average primary input is assumed too high, viz., 1,350 watts. The usual arc potential is about 70 volts. What your true watts input for the six arcs in series is, we do not know.

From the general expression for the radiation current, resistance and wattage, it is apparent that the greater the wave length the lower the efficiency becomes. It has been found that with arcs the best efficiency is realized in any certain station, excited with a small arc, when the radiated wave length is not markedly greater than that of the fundamental of the aerial. The efficiency can also be increased by elevating the aerial as pointed out in Mr. Whitney's discussion and three amperes of radiation current as indicated by your hot wire ammeter seems to us quite low.

WHAT IS A CANDLE-POWER?

(723.) Philip Ansis, Detroit, Mich., asks:

Q. 1. In illuminating work, what is meant by a standard candle-power?

A. 1. The amount of light emitted by a sperm candle seven-eighths of an inch in diameter and burning at the rate of 7.776 grams, or 120 grains, per hour.

Q. 2. What do you mean by lumen?

A. 2. The standard of luminous flux, being the light radiated from a unit source thru a unit solid angle.

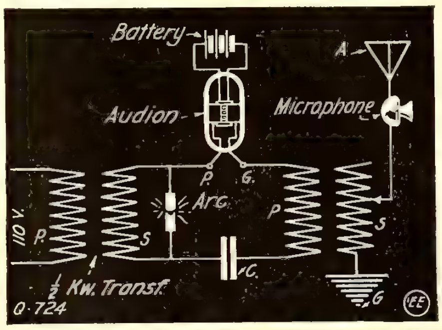
Q. 3. Define mean hemi-spherical candle-power.

A. 3. If there be drawn, from a source equally in all directions either below or above the equitorial plane, lines whose lengths are proportional to the candle-power in these directions, then the mean value of the lengths, either above or below, is the mean hemi-spherical candle-power of the upper or lower hemisphere respectively.

RADIO TELEPHONY.

(724.) Otto M. Johnson, Seattle, Wash., inquires:

Q. 1. I am enclosing a diagram of connections for a wireless telephone sending



Wireless Telephone Hook-up, Using Audion to Rectify Oscillations, as Proposed by Querist.

set, using an Audion detector as a rectifier. The diagram explains it better. I wish to know whether it will work well. The lead from the arc is connected to plate and lead to primary from the grid. The microphone is in series with aerial. If it will not work, please publish a diagram of a circuit that will.

A. 1. Your diagram as submitted to us will not work for the reason that the high tension current from the transformer will pass between the electrodes of the Audion as these are very close together. Furthermore, if rectification exists, very few oscillations would pass thru the antenna circuit. It may work if the tube is of large construction, so as not to permit the high tension current leaking from one terminal to the other.

(*Continued on page 842*)

THUNDERSTORMS OF THE UNITED STATES.

(*Continued from page 836*)

August there is, on the average, a thunderstorm every other day. Thunderstorms are less than half as frequent at the drier, lower places such as El Paso. Tampa has more thunderstorms than any other weather bureau station in the United States. In the three summer months, thunderstorms occur on about two days out of three. The summer on-shore winds supply abundant moisture and the intense sunlight at this low latitude effectively overheats the lower air. Thus the joint distribution of atmospheric instability and moisture dominate thunderstorm frequency.

Parts of Professor Ward's abstract says among other things:

"As essential characteristics of American climate, thunderstorms have a broad, human interest. From the viewpoint of climatology, the distribution of thunderstorms is of more interest than their mechanism. The part played by their rains in watering our crops is of greater importance than the size of the raindrops. The damage done by their lightning and hail concerns us more than the cause of the lightning flash or than the origin of the hailstorms. The thunderstorms of the eastern United States are among the most characteristic of American climatic phenomena. In size, intensity and frequency of occurrence they are unique. (We agree with him.—Ed.)

"In relation to man's activities, it is of significance that most thunderstorms occur at a time of year and at the hours when outdoor activities are at their height.

"Thunderstorms bring us much that is of benefit. To them we owe much, in parts of our country even most, of our spring and summer rainfall. Without these beneficent thunderstorms our great staple crops east of the Rocky Mountains would never reach maturity. One good thunderstorm over a considerable area at a critical crop stage is worth hundreds of thousands of dollars to American farmers. Our stock markets time and again show the favorable reaction of such conditions upon the prices of cereals and also of railroad and other stocks. Thundershowers break our summer droughts, cleanse our dusty air, refresh our parched earth, replenish our failing streams and brooks, bring us cool evenings and nights after sultry and oppressive days."

LONG DISTANCE WIRELESS RECORD.

A new world's wireless record for long distance work has been established on the 600-meter wave length. The steamer *Floridian* left San Francisco for Sydney, Austalia, July thirteenth. From that date up to and including July thirty-first, the vessel's position was transmitted to San Francisco. The position reports, with one exception, were received directly at the Marconi Hillcrest station, San Francisco, up to a distance of 5,227 miles.

The *Floridian* is equipt with the standard Marconi two-kilowatt, 500-cycle panel set. The current consumption at the transformer did not exceed 1,600 watts up to 2,600 miles, and at 5,200 miles the power consumed was 2,600 watts. San Francisco's signals were audible up to some 3,000 miles.

QUESTION BOX.

(*Continued from page 840*)

Q. 2. In the January, 1917, issue, page 693, The American Technical Society publisht a diagram of a radio sending and receiving set. They claim it is the best circuit yet. Please give description of instruments if possible.

A. 2. The circuit of which you speak is the one which the Marconi company was using at the time they employed the magnetic detector for receiving. This hook-up is very selective, but is little used nowadays.

DECOMPOSITION OF WATER.

(725.) Harold Nehls, Kilbourn, Wis., desires to know the following:

Q. 1. How can an alternating current decompose water, so that one-half cycle of the current will decompose the water to receive one atom of oxygen, and the other half of the cycle will obtain two atoms of hydrogen.

A. 1. It is impossible to decompose water by means of an alternating current, as the time interval of the alternating current is so small that there is little chance of decomposing the water. However, the alternating current can be converted into a uni-directional current by employing some form of rectifier, which may be either electrolytic, mechanical or electrical and then using the rectified current for the decomposition work.

GENERATOR QUERIES.

(726.) A. Baldock, Middlechurch, Mass., wants to know:

Q. 1. What factor governs the current in amperes an A.C. or D.C. generator will deliver?

A. 1. There are several factors in generator design and construction which determine the number of amperes delivered by the machine, but principally the size and number of the conductors used on the armature. It is usual to allow 600 circular mils per ampere for armature conductors.

Q. 2. What factor determines the pressure it will "throw" on the line?

A. 2. The number of conductors, size of the field coils and the speed of the armature are the main considerations which affect the pressure (e.m.f.) delivered by a given machine. Thus a generator having a large number of conductors will deliver a greater voltage than another machine of the same construction, but with fewer copper conductors. The speed of the armature is one factor which controls the voltage; the faster the armature rotates the greater the voltage will be. Also the number of magnetic lines of force delivered by the field coils are important, which quantity of course is controlled by the number of turns on the field coils and the current passing thru the coils (ampere-turns).

Q. 3. What dimensions, i.e., amount of iron, amount and size of wire, etc., should an alternator have?

A. 3. It is impossible for us to go into lengthy details here as to the design and construction of generators in this column, as it requires considerable space to cover this. We would advise you to refer to some standard text book dealing with this subject. There are a number of such textbooks on the market which are very simple and easily understood. Write our Book Department asking for a list of them.

"BEAT" RECEIVER FOR RADIO.

(727.) Kent Aitken, Tilden, Ill., desires to know:

Q. 1. How to construct a high frequency alternator similar to the one described in the October, 1916, issue of THE ELECTRICAL EXPERIMENTER to be used to receive undamped waves by the "beat system."

A. 1. The high frequency alternator de-

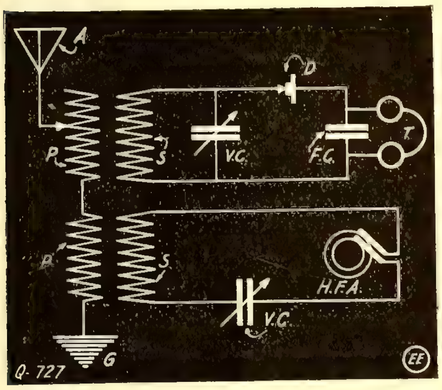
scribed in the October, 1916, issue of The Electrical Experimenter can be used for producing beats such as used by Prof. Fessenden in his heterodyne receiver. We would advise you, however, to build the generator with more pole pieces on the rotor than the one described, in order to obtain a greater frequency at a reasonable speed.

Q. 2. How would the alternator be connected with a loose coupler, loading coil, fixt condenser and receivers?

A. 2. The accompanying diagram shows the connections of the alternator in conjunction with the instruments you mention. The only additional instruments required are an inductively coupled coil and a variable condenser. The alternator is linked inductively with the primary of the loose coupler, thru the ground as will be perceived.

Q. 3. Can I receive undamped waves with the above instruments with an aerial 66 feet long and 40 feet high?

A. 3. Yes; providing you employ large enough loading coils to tune the wave length which the undamped wave transmitter is emitting.



How High Frequency Alternator (H.F.A.) Is Linked Up With Antenna Circuit in Order to Produce "Beats" for Receiving Undamped Waves.

RESISTANCE MATERIAL.

(728.) Fritz G. Chappies, Callao, Peru, S.A., asks:

Q. 1. Which will be the best material over which to wind resistance wire for electric stoves provided mica is not available, and what will be the best insulating composition to secure the same resistance wires in place?

A. 1. If mica is not at hand, the next best material to use for winding the heating unit is slate, porcelain or soap stone. German silver wire is often used for making up the heating element. However on larger units, special composition wire is usually employed.

Q. 2. Should the wires work to a red heat, or what will be the best working temperature?

A. 2. The wires should be kept just a shade darker than cherry red. This temperature is best, as the heat developed at this point is quite intensive, but not too much so, to keep the wire in good shape.

Fine Portland cement is recommended as a filler to keep the wires in place. After it has "set," the heating unit is compact and rigid. Rheostats are built in this manner.

ALTERNATOR QUERY.

(729.) L. Weiss, Brooklyn, N.Y., wishes to know:

Q. 1. What advantage have constant current alternators over constant current dynamos?

A. 1. The high pressure current is delivered to the external circuit without a commutator, hence there is no sparking difficulty. This relates to the revolving field

type of alternator. There are, however, alternators in which the armature revolves, the current being delivered to the external circuit thru collector rings and brushes. It should be noted that this type of alternator is for moderate pressures and moreover there is no interruption in the flow of current such as would be occasioned by a tangential brush on a dynamo in passing from one commutator segment to the next.

In the revolving field machine, altho the armature current be of very high pressure, the field current which passes thru the brushes and slip rings is of low pressure and accordingly presents no transmission difficulties.

Q. 2. In a constant current series system upon what does the voltage at the alternator depend?

A. 2. The number of devices connected in the circuit, the volts required for each, and the line drop.

Q. 3. Does the difference in transformer capacity represent all the saving?

A. 3. No; one large transformer is more efficient than a number of small transformers connected to the same circuit.

MAGNETIC ATTRACTION.

(730.) I. Marks, Clermont, N.J., inquires:

Q. 1. How can one calculate the force with which a magnet attracts another magnet or a piece of iron?

A. 1. The force between the two equal magnets can be determined by the area of the common surface multiplied by the square of the number of lines of force per square centimeter divided by 25.14 or multiplied by .04. We have therefore:

$$P=\frac{B^2A}{8\pi}=.04\,B^2A$$

Suppose two pieces of iron 1 cm. sq. and of any convenient length are bent into two half circles and that the current is sent thru a coil of wire wound about one or both pieces so as to magnetize the iron to a saturation of 5000 lines per sq. centimeter; the force at each point between the two parts of the ring will be .04x1x5000x5000=.04x 25,000,000 = 1,000,000 dynes; the total force will be the sum of that at the two joints, or double that at one, hence, the total pull is 2,000,000 dynes. Since 981 dynes equals the weight of one gram, the total pull between the two pieces is 2,000,000 divided by 981, or 2024 grams, or about 4.4 lbs.

Q. 2. How can it be shown that the lines of force tend to become as short as possible?

A. 2. This is illustrated by the well-known phenomenon of attraction as when a magnet attracts its keeper. Familiar examples are the telegraph sounder and the electric bell.

TELEGRAPH LINE QUERIES.

(731.) L. Kandiel, East Pittsburgh, Pa., wishes to know:

Q. 1. What is meant by quadruplex telegraphy and for what purpose is it used?

A. 1. The quadruplex system as used today provides for the simultaneous transmission of two groups of signals in one direction and two groups of signals in the opposite direction, without interference and over a single telegraph line.

Q. 2. How is a simple duplex telegraph line connected so as to enable one to send simultaneously over the same line without interference?

A. 2. The diagram herewith gives the connections of a simple differential duplex telegraph line. It consists essentially of a differentially wound relay in each station and connected as shown. The resistances R, at each station, are of such magnitude that they are equal to the resistance of the line. This resistance is called the artificial line of the circuit; it is usually shunt-

ed with a condenser of proper capacity.

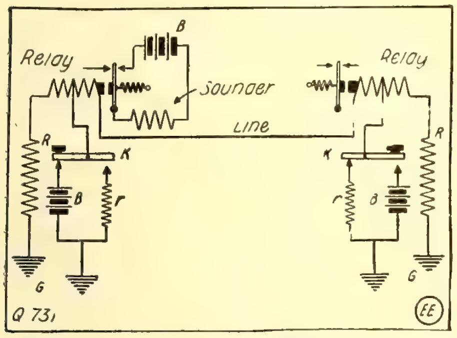
Q. 3. Is it possible to determine the maximum working distance with the simple telegraph system provided the various factors of the system are known?

A. 3. Yes; it is possible to determine the maximum working distance that one can use the line. The following algebraic expression will answer your question:

$$l = \frac{1}{R}\left[\frac{E}{I} - 2\,Rs\right]$$

Where:
- 1=maximum distance in miles that you can transmit
- R=resistance of the line including the ground return
- E=voltage
- I=minimum current required to actuate the recording instrument
- 2Rs=resistance of the recording instrument

(The factor 2 is used as there are two instruments used in the circuit.)



Connection for Simple Differential "Duplex" Telegraph Line, Utilizing Differentially Wound Relays at Each Station.

CHANGING MOTOR RESISTANCE.

(732.) F. Jewett, Savannah, Ga., asks:

Q. 1. Is it possible to change the resistance of an armature?

A. 1. Only by rewinding it. It should be remembered, however, that part of the resistance of the armature circuit is at the contact between brushes and commutator. Therefore, a motor with an unclean or uneven commutator, loose brushes or poor connections will not run at so uniform a speed as when put in first class running order. Any excessive heat around the brushes or holders should therefore be investigated.

Q. 2. How does a change in the field resistance affect the torque of a motor on a constant potential circuit?

A. 2. The effect in such a case is more complicated than in the preceding case, for a change in the field affects the current and both the speed and torque are apt to change in consequence. With a given current, the torque would be increased, by strengthening the field; but the stronger field increases the counter-electro-motive force for the same speed, and this reduces the current. Under ordinary conditions it is found that strengthening the field of a motor on a constant potential circuit causes a more than proportional decrease of current. The result is that within the limits met in ordinary practice, the torque, speed and the power of a motor on a constant potential circuit are actually increased by weakening the field.

POTENTIOMETER.

(733.) J. Paldon, Harrison, N.J., writes:

Q. 1. Is it possible to employ a potentiometer to measure the e.m.f. of a dry cell?

A. 1. Yes; it is the only positive method of measuring the e.m.f. delivered by a cell. However, the resistance of the potentiometer must be very high. In conjunction with this instrument, it is necessary to employ a standard volt cell connected with a sensitive galvanometer.

Q. 2. What do you consider the best material for building a potentiometer for this kind of work?

A. 2. The simplest method of making such an instrument is by winding German Silver wire upon an insulated form. This wire should be wound non-inductively, and it can be done by doubling the wire and winding both of them on the insulating form.

Q. 3. What do you consider best for selective tuning of either of the following instruments, namely, The Electro Importing Co.'s vario-selective coupler or an ordinary loose coupler outfit?

A. 3. As far as selectivity is concerned, we believe that the vario-selective coupler is better and more efficient than an ordinary loose coupler system.

RADIO QUERIES.

(734.) J. Lamat, Long Island City, L.I., asks:

Q. 1. What is the wave length of my antenna, which consists of four wires each 100 feet long and 80 feet high?

A. 1. The maximum natural wave length of your antenna is 340 meters.

Q. 2. How can I reduce this wave length so as to comply with the Government requirements?

A. 2. By connecting a condenser in series with the ground.

Q. 3. What type of antenna do you consider best for transmission work?

A. 3. The "T" type antenna is best suited for general transmitting work.

INDUCTANCE.

(735.) Charles Mantel, New York City, N.Y., wants to know:

Q. 1. How does inductance cause the current to lag behind the voltage?

A. 1. It tends to prevent changes in the strength of the current. When two parts of a circuit are near each other, so that one is in the magnetic field of the other, any change in the strength of the current causes a corresponding change in the magnetic field and sets up a reverse pressure in the other wire. This induced pressure causes the current to reach its maximum value a little later than the pressure, and also tends to prevent the current diminishing in step with the pressure.

Q. 2. Why is capacity reactance given a negative sign?

A. 2. Because it reacts in opposition to inductance; that is, it tends to reduce the spurious resistance due to inductance. In circuits having both inductance and capacity, the tangent of the angle of lag or lead as the case may be is the algebraic sum of the two reactances divided by the resistance. If the sign be positive, it is the angle of lag; if negative, it is the angle of lead.

FLASHER.

(736.) Paul Andrews, Greenpoint, N.Y., asks:

Q. 1. Upon what principle does the thermo flasher operate?

A. 1. This type of flasher works on the thermal or heat expansion principle; that is, the movement of the contact points of the flasher necessary to open and close the circuit, is obtained automatically by the alternate heating and cooling of a metal bar in the flasher, which causes it to expand and contract.

Q. 2. What should be done with the old electrolyte of a storage battery?

A. 2. When a battery is taken down, the electrolyte may be saved and used when reassembling the battery, providing great care be exercised when pouring it out of the jar, so as not to draw off with it any of the sediment. It should be stored in convenient receptacles, preferably glass or earthenware carboys, which have been

thoroly washt and never used for any other purpose.

EDUCATIONAL INSTITUTIONS.

(737.) C. Bernhardt, Brooklyn, N.Y., wishes to know:

Q. 1. Where can I take a night course in Electrical Engineering somewhere in Brooklyn?

A. 1. There are two educational institutions in Brooklyn where you may learn Electrical Engineering, namely the Pratt Institute and the Polytechnic Institute. The former school offers a two-year course, which is of a practical nature and does not give any degree, while the latter is a College of Engineering and its courses during the day are of four years' duration at the end of which time the student is given a degree in Electrical Engineering when he has completed his course.

Q. 2. How can I obtain information as to the studies given at Yale University, Worcester Polytechnic Institute, Boston Polytechnic Institute and Harvard University?

A. 2. Relative to school addresses would advise that you communicate your inquiries regarding studies, etc., at Yale University to the Registrar, Yale University, New Haven, Conn.; the Registrar of Worcester Polytechnic Institute, Worcester, Mass.; Registrar of Boston Polytechnic Institute, Boston, Mass.; Registrar Harvard University, Cambridge, Mass.

RANGE OF INSTRUMENTS.

(738.) J. C. O'Donnell, N.S., Pittsburgh, Pa., desires:

Q. 1. The wave length of a three-wire aerial two hundred feet long and fifty feet high.

A. 1. This aerial has a natural wave length of 400 meters.

Q. 2. The probable range of the following set with the above aerial; two thousand meter loose coupler, variable and fixt condenser, silicon detector and two thousand ohm 'phones.

A. 2. You should have no trouble in receiving 1200 to 1500 miles with your instruments.

Q. 3. Could NAA (Arlington) be received with an eighty-foot aerial and two thousand five hundred meter loose coupler?

A. 3. Yes; providing a proper capacity variable condenser is shunted across the secondary of the loose coupler.

VOICE-OPERATED TYPEWRITER.

(739.) The A. T. Co., New York City, wish information on the voice-operated typewriter described in the April, 1916, issue of The Electrical Experimenter.

A. 1. We would advise that the *Phonoscribe* as developed by Mr. Flowers is not on the market.

The article as publisht in this magazine was finisht to commercial completion, so to speak, by our editorial staff. However, Mr. Flowers has exercised wonderful ingenuity in devising special arrangements for the operation of such a voice scriber, and, quite possibly, in the reasonably near future, you may be able to purchase such a machine on the open market.

If you wish to inquire into this matter further, you may communicate with Mr. Flowers, addressing him in care of the American Institute of Electrical Engineers, 37 West Thirty-ninth Street, New York.

AUTOMOBILE HOIST IN WIRELESS WORK.

Workmen on the masts of the Marconi station at Bolinas, Cal., were raised aloft by means of tackle connected to a touring car, the car engine supplying the hoisting power.

THE WASHINGTON'S BIRTHDAY RELAY, FEB. 24, 1917.

(*Continued from page 805*)

being temporarily out of service. Now all of you wanted something hard, so go to it and get the M.S.G. from New York and also get the one coming from Los Angeles, Cal., as soon as you get these M.S.G.s deliver them to the mayor or highest civil authority in your city and get his receipt and mail them at once to 9XE, Davenport, Ia., no name, just "9XE" that's all, so that I may get to work again and work all night on the write-up, in order that you may read it in your magazine. If you want the wave length of the various sending stations look in the Government call-book; only the sending stations will be given this information, as each will receive a personal letter from the writer in good time before the relay. Now you all wisht this hard work on yourself so it is now up to you; the results of the relay depend upon those *who do not send,* those keeping quiet and those asked to send to keep quiet after getting Q.S.L.

We are anxious to get the M.S.G. from both coasts to New Orleans and believe we must use the following route: 6EA, with 6DM and 6SH, alternates if needed, 9ZF, 5DU, Emerson, Dallas, Texas, 9ABD, Corwin, Jefferson City, Mo., 9GY, Kern, Matoon, Ill., 8AEZ, west, Lima, Ohio, 2AGJ, Hewitt, Albany, N.Y., and 1IZ, our old "bright star in the East," Robert T. St. James, who must get it back to New York City mayor thru a local station. 5ZQ, St. Charles College, Grand-Coteau, La., and 5ZD, C. B. De La Hunt, Memphis, Tenn., have agreed to help getting the M.S.G. to 5ZS, W. Anthony, Shreveport, La., if he does not get it direct from 9ZS or 9XV or 5ZC on the way west, but they are asked not to send if 5ZS-Q.S.L.'s promptly, or they will QRM route west at 9ZF.

Mr. and Mrs. C. Candler are requested to get M.S.G. going west from N.Y. and send it on 200 meter wave on a Q.S.T., three times after M.S.G. leaves 9ZN and 5ZC, going west; this is for the benefit of all the southeast stations from Baltimore to Florida, as they will be listening for 8NH. They will also give return M.S.G. from west on a Q.S.T. three times for the benefit of the same stations, but 8NH will not send this M.S.G. on its return from 6EA until 1IZ acknowledges Q.S.L. Station KIX, Denver, and KIW, Mr. Colburn, Ajax mines, Victor, Colo., will be on the job to help us out at this point, which is a hummer and has caused the writer many gray hairs. Among the many special stations agreeing to help are Cornell University, University of Pittsburgh, Ohio State University, Illionis Watch Co., thru our old friend 9ZS, Mr. G. S. Johnson; State University of Iowa, Iowa City; Professor Ford, University of North Dakota, Grand Forks; Professor Taylor, Washington University, St. Louis; Professor Blatterman, to whom with Professor Taylor, we are all indebted for our real information on long distance sending. Rev. Fr. Phillippe, St. Charles College, La.; Rev. Ruth, St. Martins College, and our old friends, Mathews, in Chicago, who is now in charge of Special station 9ZN, formerly 9IK, Corlett 5ZC, Dallas, Texas, who says there are only four states in the country that have not heard my "sigs," and the other well-known boys who have worked hard at the game and on whom will fall the burden of putting this M.S.G. thru. Don't forget boys, we are working against time; so cut out QRM as the special stations are going to try and make better time than the amateurs in these messages, and truthfully I want the amateurs to *lick them to a splinter.* Write 9XE about any Q.R.M.

whether from commercial or Government stations.

None of the operators at these stations were born with receivers on their ears; they all had to learn and plenty of them have still more to learn; so we hope they will not be so impatient on this night and try to *hog the air*. We hear Government stations every night hogging the air with lots of fool stuff worse than amateurs and numerous commercials calling each other names—we hear you boys, so have a heart and give us a real chance to make good—so we may be able to work *with* you later and not *against* you. The writer's experience in the U.S. Navy taught him that there are many points of etiquette yet to be acquired by the commercial class as a body, but you are all good scouts, so help us out just a little for the "love of mike," and give us just a few minutes out of the 525,600 minutes in the year to try out our schemes.

PRIZES.

The Thordarson Co., of Chicago, Ill., have donated again a 1K.W. transformer, which you almost won on the Presidential Relay, November 27, 1916. The Electro Importing Co., of New York City, have very kindly donated one of their "Nauen-POZ" Radio Receiving Sets (first prize) and one of their "Professional" Wave Meters (second prize). The W. B. Duck Co., of Toledo, Ohio, have donated one of their celebrated "Arlington" tuners. The Mesco Co., Chicago, Ill., thru their Mr. McGivern,

donated a pair of their 3,000 ohm Mesco 'phones. The F. B. Chambers Co., of Philadelphia, Pa., will give a prize and it will be one of their No. 748 or 749 Tuners. The Adams-Morgan Co., Upper Montclair, N.J., will also donate something worth your while and a number of other manufacturers have agreed to give plenty of things. The full list of prizes will be publisht in the April issue of "EE" and the disposition of them will be determined after consulting the donees and the amateurs of the country after the Relay.

Don't forget the final reckoning will be made after this Relay and the number of credits you receive will determine along with the number received on the last Relay as to who gets the best prize of all.

Letters with receipts of M.S.G. and reports with post-marks on the letters showing they have been mailed more than forty-eight hours after midnight, February 25, 1917, cannot be entered in the final round-up for the write-up so please get busy at once boys and send your dope in at once, i.e., right after the Relay.

We received so many requests to have the Relay on Saturday, February twenty-fourth, that we decided to hold it at that time and if any hitch comes in getting the M.S.G. west or east we will start the same time Sunday night, the twenty-fifth, and do it all over again. Another thing, if the east bound M.S.G. gives any trouble com-

ing from Los Angeles, 6DA, we can have the chance of our lives for a little early morning work and still be in time for church. As a last call boys, do your very best to keep your sets quiet during the Relay—I know it is a tough job *to listen and hear not*—I have been there—but try it just once; take out your fuses and resolve for this one night you will not arbitrarily spoil the work of thousands by a few moments' unnecessary sending. Now I have done my part and the rest is really up to you—go to it and luck to you.

Cordially yours,
9XE,
Davenport, Ia.

The following stations are appointed "monitors of the ether" and will report any Q.R.M. from amateur, special, commercial or government stations; even the *Allies* are requested to keep quiet for a few moments!!

C. F. Ouidin, 2AFT, Schenectady, N.Y.
Graceland College, 9YO, Lamoni, Ia.
The Old War Horse, 9RD, Clinton, Ia.
O. R. Terry, 9HQ, Stoughton, Wis.
MacQuarrie, 6SH, Stockton, Cal.
H. P. Maxim, 1ZM, Hartford, Conn.
W. A. Parks, 3ZW, Washington, D.C.
Lieutenant for, 1IZ, Massachusetts.
D. R. Simmons, 5AX, Shreveport, La.
D. H. O'Neill, 9DK, St. Louis, Mo.
Mr. and Mrs. Candler, 8NH, St. Mary's, Ohio.
C. Dunning, 8YZ, Pittsburgh, Pa.
F. B. Chambers, 3XC, Philadelphia, Pa.
H. Brownell, 5AM, Birmingham, Ala.
W. T. Gravely, 3RO, Danville, Va.
W. S. Rothrock, 4DI, Winston-Salem, N.C.
A. A. Herbert, District Manager, A.R.R.L., New Jersey.
F. F. Merriam, 4CL, Atlanta, Ga.
S. Greenleaf, 9ZG, Woodstock, Ill.
W. Reinhart, 9BW, Omaha, Neb.
W. S. Ezell, 9YE, Wichita, Kans.
Cedric E. Hart, 6SL, Salt Lake City, Utah.

THE CALCULATION AND MEASUREMENT OF INDUCTANCE.

(*Continued from page 813*)

Substituting the values for F′ F″ in equations (8) and (9) we obtain for F′ (1.12) and F″ (1.03995). Solving the above we obtain for L=.000198 henry or 198,050 centimeters of inductance.

It will be observed that the shape correction factors are very small and the larger the coil becomes the nearer will they approach unity; for this reason they may be neglected for coils whose diameters are one-tenth that of their length.

For long inductances, such as those used in the regenerative Audion circuits for receiving undamped waves, the above formula is particularly useful. As an example, the inductance of a long wave loading coil, consisting of a single layer of No. 28 S.S.C. magnet wire, wound on a cardboard tube 28 inches long (26 inches of winding) and 5⅝ inches outside diameter was ascertained to be 76,355,400 cms. Using this coil in series as a loader, with a 4 wire, 500 ft. flat-top, inverted "L" antenna, 100 ft. high, and with a loose coupler primary having 9,400,000 cms. of inductance, the wave length capacity figures out to about 22,900 meters; sufficient for practically all experimental requirements.

The formulæ given herein for calculating the inductance of coils is for the *current-sheet* value, and apply accurately only to a winding or infinitely thin metal strip, which completely covers the solenoid, the successive turns being supposed to meet at the edges without making electrical contact, and so realizing a uniform distribution of current over the surface. If we have a winding of insulated wire or of bare wire wound in a screw thread, we may have

(*Continued on page 854*)

THE U.S. NAVAL OBSERVATORY.

With increased and increasing speed of our warships, increased fighting ranges, and the continuing development of submarines and aircraft has come the necessity for new and more rapid methods of navigation and plotting, which the Naval Observatory has met by encouraging suggestions, aiding in the development of methods and instruments, making trial of all such as give promise of usefulness and furnishing to the service those that have proved of value.

The usefulness to navigation and to the country in general of the daily time service has been added to by the installation of two up-to-date transmitting clocks and arrangements for checking the actual emission of the radio time signals, which are now received thruout the country east of the Rocky Mountains and the contiguous oceans for several thousand miles, according to the report of the Secretary of the Navy. The time for the country west of the Rocky Mountains and for vessels navigating the north and east Pacific Ocean is sent out from the navy chronometer and time station at the Mare Island Navy Yard.

The routine astronomical work of the observatory for keeping track of the heavenly bodies has been kept up, a photographic zenith tube telescope for determining the variation of latitude added to the plant, and the photographic work extended One volume of observations and an appendix, "Determination of the Difference of Longitude between Washington and Paris, 1913-14," have been publisht. The 1916 Nautical Almanac contains improvements and additions over previous issues, and tables have been gotten out to add the times of sunrise and sunset and moonrise and moonset in future editions. For the ensuing year the Naval Observatory will continue its routine work of furnishing time, Nautical Almanacs, and navigational instruments; and it is hoped will be allowed a small appropriation for preparing and fitting out a party to observe the total eclipse of the sun, of June 8, 1918, the path of which will cross the United States.

SHOOTING BIG GAME ON THE ELECTRIC "MOVIE" TARGET.

(Continued from page 793)

gers, each operated by a separate spring in three-quarters of an inch space is not advisable.

To avoid this difficulty the screen is first divided into zones, and in each zone there are five wires; the zones were represented by letters and the wires by numbers. Thus a bird in the center of the screen would be in front of the ball which connected wire D1 with wire H1. There are vertical zones and horizontal zones. Therefore, to establish the location of any object in the picture, nine fingers were required for the vertical and nine for the horizontal, and at each operation two fingers were necessary, one to establish the zone and one to establish the wire dropt thru the film perforations for the horizontal and one zone finger and one individual finger to establish the vertical wire so that each picture carried four perforations.

A special device has been built for perforating the film and which works automatically. This is the most amazing piece of work ever attempted by any human being and its inventor certainly deserves credit for his time spent in developing the electric moving picture target.

TRAVELING AT 500 MILES PER HOUR IN THE FUTURE ELECTRIC RAILWAY.

(Continued from page 794)

means of powerful electric solenoids placed along the track, as shown in the accompanying plan view. The details of switching, etc., are not given, as there are several different ways in which this could be taken care of, but in some of the schemes developed in this direction, the opening and closing of the solenoid circuits as the car progresses on its way, is functioned or cared for by the movement of the car itself. In other words the car, as it moves along, passes over a set of electrical contacts placed between solenoid points, so that the solenoid is deënergized just as the car approaches it; the momentum of the car carrying it forward owing to the powerful magnetic pull of the solenoid which had acted on the car a brief instant before. This is the principle upon which electro-magnetic guns operate also.

There is still another way to reduce the initial installation expense of such a railway system, by placing the locomotion coils or electro-magnets within the car, or rather on the car; these moving solenoids to act on iron rings or armatures of suitable cross-section placed along the track The current can be periodically switched on and off automatically, so as to act in the manner above described, whereby the electro-magnet coil would be deënergized just at the instant where the moving car is approaching the point of maximum magnetic pull. In any event, this particular action simmers down to the point where what is required is a powerful electro-magnetic pull between an iron mass and the electro-magnet.

This all sounds very simple, as well as impracticable, but a system of this kind can be worked out, and has been tried out, in fact, in the laboratory by M. Bachelet and other inventors, with track systems having a length of 1,700 feet and more.

Such a high speed, tubular electric railway system would have many advantages over present day methods of transportation, and one of these is that the peculiar design of such a railway lends itself well to support on a single row of steel towers in the manner shown on our front cover, and the elimination of local stops.

While the hypothesis and ideals of Professor Weinberg as previously outlined, not to mention those of numerous other inventors and scientists, have often been rudely shattered by the more level-headed and slow-going intellects of the day, it really does not seem so rankly impractical to conjecture on the possibilities of such a high speed railway somewhat of the type here described. A fortune awaits the man who is big enough for the job. It wants another Tesla or Edison and he is bound to arrive sooner or later.

OXYBENZYLMETHYLENGLYCOLANHYDRIDE.

(Continued from page 801)

percha, one of the best of the old insulators, a specific resistance but little higher.

BAKELITE-MICARTA is the name of a remarkable material developed a few years ago by the Westinghouse research specialists. Primarily it is an insulating material, but is also a superior product for various other purposes.

Bakelite-Micarta is a hard, insulating material of high dielectric and mechanical strength, which will not warp, expand, or shrink with age or with exposure to the weather. It is infusible and remains unaffected by heat until a temperature is

reached that is sufficiently high to carbonize the material. Heat does not warp it, and it will stand an electric arc better than hard fibre, hard rubber, built-up mica, or any molded insulation of resinous or fibrous material. The coefficient of expansion is low—about .00002 per degree Centigrade. It is insoluble in practically all the ordinary solvents such as alcohol, benzine, turpentine, weak solutions of acids and alkalies, hot water, and oils, and is not affected by ozone, a feature that makes it superior to hard rubber, resin, etc., for electrical purposes. It is water-resisting and non-hydroscopic. Bakelite-Micarta can be sawed, milled, turned, tapt, and threaded. It can be punched only in thin sheets and cannot be molded. It takes a good polish and is accurate in thickness within close limits. It is made in various grades in plates, tubes, and rods, all having the same general characteristics, but differing in specific points to adapt them to different kinds of service.

The Bakelite-Micarta plate is made in various grades, having different characteristics. Each grade is designated by a number.

For instance the No. 213 plate is the standard one and is tan in color. It is useful for all applications where high mechanical strength is required, or for general application, on account of its electrical and mechanical qualities. For short periods it will stand temperatures as high as 140 degrees Centigrade and has a breakdown voltage of approximately 400 volts per mil. It will stand continuous service at 25 to 50 volts per mil. Its specific gravity is 1.25, its tensile strength approximately 19,000 lb., per square inch with the grain, and its strength under compression approximately 40,000 lb., per square inch across the grain. It can be sawed to size and drilled and tapt against the grain; it can be punched with simple dies in thicknesses up to 1/8 inch. It is furnished in sizes from 1/64 to 2 inches thick, up to 36 inches square. No doubt about it—Bakelite fills a distinct want in the commercial electrical field.

Russia Wants More Electric Stations

A committee on Russian industrial affairs reports that there is need for a rapid increase in the means for generating electric power in Russia. At present there are 93 generating stations with a capacity of 79,533 kilowatts in European Russia.

EXPERIMENTAL PHYSICS.

(*Continued from page 804*)

sufficiently large cork stopper is available a milk bottle will be just the thing. Puncture two holes in the cork as far apart as practicable. Bend two hairpins as in figure 9, and stick them thru the two holes in the cork so that they are about 1/2 an inch apart at the lower extremity. Soak a wad of cotton about the size of a small marble in gasoline, benzine or ether. Place the wet wad in the bottle and cork the bottle rather tightly. Insulate the leads coming from a small spark coil (a 1/2-inch wireless spark coil works admirably) so that they can be held in the hands. After having moved away to a safe distance (in an extreme case the bottle might burst), touch the ends of the hairpins (a) with the leads. An explosion occurs and the cork stopper is projected upward. Wet another wad of cotton with the same liquid and place it on a piece of asbestos, marble, or slate and light it. It is found to burn quietly without explosion. In the first case the vapor of the gasoline mixed with the air in the bottle and the mixture on being heated by the spark, formed a gas which would normally occupy a much larger volume. This was the case of a large amount of gas in a small volume exerting a force great enough to cause the cork stopper to be pushed out. In the second case a large amount of gas was also formed but the gas was not confined to a small volume but could occupy the necessary volume in the atmosphere and hence we had no explosion. The gasoline engine is nothing but a contrivance for making explosions in succession; these explosions being utilized to move a piston, which in turn causes a wheel to rotate.

Experiment 10. Mix two parts (by weight) of Potassium Nitrat with one part of sulfur and three parts of charcoal. This gives the familiar mixture called gunpowder. If a match is applied to this mixture (it is not advisable to use more than about a teaspoonful) it will be found to burn quietly just as the gasoline did in the preceding experiment. If, however, some of the mixture is placed in a toy cannon and set off by the aid of a fuse, an explosion occurs analagous to the first part of the preceding experiment. The ordinary fire cracker or salute, is nothing but gunpowder packed tightly in a small space and a fuse leading to it. The fuse is nothing but some gunpowder wrapt loosely so that it burns quietly but steadily. A very good way of setting off fireworks for those who wish to celebrate the Fourth of July safely and sanely but noisily, is seen in figure 10. The figure is self-explanatory. The terminals of the secondary of the spark coil (hairpins or heavy wire) are placed so that the protruding ends are close together enough so that the spark will jump across but far enough apart at all other points so that the spark will not jump elsewhere. The switch is placed at a safe distance. This experiment was tried very successfully by a young experimenter, Mr. Arthur Pickett, using a "Bull-dog" spark coil.

If we strike a sharp blow on some of the gunpowder, we notice no effect. If, however, we mix equal parts of Potassium chlorat and Sulfur, we find that the force of the blow is sufficient to set it off. Efficient miniature torpedoes are made by wrapping a *small* amount of this mixture together with a small marble in tin-foil. If thrown up and permitted to land on something hard, such as the pavement, the force of the marble striking is sufficient to detonate it. On mixing four parts of this mixture with one of powdered Magnesium, a good flash powder is made, which can be used for photographic purposes. Finally the ordinary bullet is an application of the principles underlying these two or similar mixtures. Here (d) is a brass shell, (a) is steel or lead, (b) is gunpowder, which on being sufficiently heated, explodes and propels (a) forward; (c) is the fulminate, i.e., the mixture which is set off by the blow of the trigger, the heat given off by which, sets off the powder. (See figure 11.)

Nitrocellulose is a substance far more powerfully explosive than either of these two mixtures and since on explosion it gives off all colorless gases, it is used in the manufacture of smokeless powder. Nitroglycerin resembles nitrocellulose in the violence of its explosive effects. One volume of nitroglycerin yields about 1300 volumes of gas, which by the heat of reaction expands to 10,000 volumes so that the force exerted is indeed enormous. A mixture of Sodium Nitrat, wood pulp and nitroglycerin is called Dynamite, which can be handled with less danger. Recently the Germans have developed a powerful explosive called Trinitrotoluene, which is prepared by the action of nitric acid on toluene. It is a solid and can be transported with safety.

(To be continued.)

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

SAFETY SWITCH GUARD.

(128.) John T. Dwyer, W. Philadelphia, Pa., has submitted to us a Safety Guard for preventing electrocution or shocks from touching the metal on knife switches, the safety guard being arranged in such a manner that it will enclose the blade and at the same time help prevent the switch from being opened or closed. Our opinion is asked as to the patentability of the same.

Another device is also submitted, being a spirit level to determine whether a board's surface is horizontally true.

Answer. Concerning the knife switch guard, this is a very good idea, but unhappily, we believe the high cost of making such an article of hard rubber or other insulation, on account of the amount of material needed would make the device prohibitive, as far as its commercial phase is concerned. The idea, nevertheless, is an excellent one.

As to the spirit level, we think this a good idea and a patent might be obtained upon it, but would suggest that you have a patent attorney make a search as to the patentability, first.

TRAIN STOPPING DEVICE.

(129.) P. Traniello, Natick, Mass., sends us a sketch and writes as follows:

"I am sending you herewith illustration of a train stopping device, which I think will stop a train in case an engineer should try to pass a danger signal set against him. Would like to have your advice as to whether such a system is practical and whether a patent can be obtained on it."

Answer. We have carefully looked over the idea, but it seems to us that the idea is not practical enough to warrant railroads using it. Besides, there is a very similar device used at the present time in the New York Subway, and the usual automatic block systems which are now in vogue all over the country are a great deal simpler, involving less expense, and seem to us to be capable of working with more certainty than the device submitted.

PORTABLE ELECTRIC BRUSH.

(130.) G. Ladermann, New York City, encloses sketch and description of a portable revolving brush which he thinks would come in handy for porters, who have a good deal of brass to polish, also for jewelers and the like. Is the idea new and is it patentable?

Answer. Nothing new is contained in the suggestion. Merely by putting a revolving brush on a portable motor does not make the article patentable, as no new features are contained in the device. By just taking a motor and mounting some sort of revolving article on it does not entitle you to a patent.

SELF-SENDING KEY.

(131.) Robert L. Hazeltin, Jamestown, N.Y., has submitted a scheme for a self-teacher to learn the code which is operated by a motor and perforated tape. Our advice is asked whether this can be patented.

Answer. There is nothing new contained in this idea, which is practically the identical thing being manufactured at the present time by the Dodge School of Telegraphy Co., Valparaiso, Ind., to whom you might write for their catalog.

COHERER.

(132) Harold Stanford, Lawton, Okla., has sent us in a description and illustration of a special coherer which is excited by electro-magnetic means in a certain manner. Our advice is asked if the device is patentable and whether it has any market value.

Answer. Your device in itself is not new. Similar devices have been patented before. What seems to us as being new, however, is the manner of connecting the coherer to the aerial and ground, which seems novel and possesses several meritorious features. However, without having tested the device we could not offhand tell whether it would be practical for long distance receiving or even for short distance work. We would advise you to have careful tests made before patenting the article.

SWITCH.

(133) Albert H. Beiler, New York City, asks:

"Will you please inform me of the practicability of a device by means of which a single-pole, single throw knife switch may be made to operate any number of lamps with successive intervals, lighting only one lamp at a time. Thus, by closing the switch, Light No. 1 will light and remain so until the circuit opens again. With the circuit now closed a second time, Light No. 2 will light and remain so until the circuit is again opened, and similarly with any number of lamps.

Answer. The idea is a good one, but without more information about the construction it is impossible to fully advise one. There is unquestionably a demand for devices of this sort, but you should not forget that they must comply with the regulations of the Fire Underwriters, which are very strict, and not all the devices lend

themselves to commercial exploitation for that reason. We would advise you to get in touch with a patent attorney.

THE CALCULATION AND MEASUREMENT OF INDUCTANCE.

(Continued from page 850)

a greater or less self-inductance than that given by the current sheet formulæ. This depends upon the ratio of the diameter of the wire to the pitch of the winding. Taking L for the actual self-inductance of a coil and Ls for the current-sheet value as found by any of the formulæ herein cited, we obtain the expression:

$$L = Ls - DL;$$

The quantity DL is found by solving the following equation:

$$DL = 4\pi \times a \times n(A+B);$$

Wherein
a=mean radius of coil in cms.
n=whole number of turns in coil.
π=3.1416.

While A and B are constants to be taken from the accompanying tables I and II. The correction term A is dependent upon the size of the bare wire, having diameter "d," as compared with the pitch "P" of the winding, or on the value of the ratio $\frac{d}{P}$. The two values must be in units of like denomination, i.e., either in cms. or in inches. When the value $\frac{d}{P}$ becomes less than 0.58, A is negative and in such cases when the numerical values of A are greater than those of B, which is always positive, the correction DL becomes negative, and hence L will be greater than Ls.

The correction in the inductance value for high frequency circuits may be made as follows: Subtract from the inductance L, as above corrected, one-half the length of the conductor on the coil in centimeters.

TABLE I

Values of Correction Term "A," depending on the ratio $\frac{d}{P}$ or the Diameter of Bare and Covered Wire on the Coil

$\frac{d}{P}$	A	$\frac{d}{P}$	A	$\frac{d}{P}$	A
1.00	0.5568	.80	0.3337	.60	0.0460
.99	.5468	.79	.3211	.59	.0292
.98	.5367	.78	.3084	.58	.0121
.97	.5264	.77	.2955	.57	−.0053
.96	.5160	.76	.2824	.56	−.0230
.95	.5055	.75	.2691	.55	−.0410
.94	.4949	.74	.2557	.54	−.0594
.93	.4842	.73	.2421	.53	−.0781
.92	.4734	.72	.2283	.52	−.0971
.91	.4625	.71	.2143	.51	−.1165
.90	.4515	.70	.2001	.50	−.1363
.89	.4403	.69	.1857		
.88	.4290	.68	.1711	.50	−.1363
.87	.4176	.67	.1563	.45	−.2416
.86	.4060	.66	.1413	.40	−.3594
.85	.3943	.65	.1261	.35	−.4928
.84	.3825	.64	.1106	.30	−.6471
.83	.3705	.63	.0949	.25	−.8294
.82	.3584	.62	.0789	.20	−1.0526
.81	.3461	.61	.0626	.15	−1.3403
.80	.3337	.60	.0460	.10	−1.7457

TABLE II

Values of the Correction Term "B," depending on the Number of Turns of Wire on the Single Layer Coil

No. of Turns	B	No. of Turns	B
1	0.0000	50	0.3186
2	.1137	60	3216
3	.1663	70	.3239
4	.1973	80	.3257
5	.2180	90	.3270
6	.2329	100	.3280
7	.2443	125	.3298
8	.2532	150	.3311
9	.2604	175	.3321
10	.2664	200	.3328
15	.2857	300	.3343
20	.2974	400	.3351
25	.3042	500	.3356
30	.3083	600	.3359
35	.3119	700	.3361
40	.3148	800	.3363
45	.3169	900	.3364
50	.3186	1000	.3365

[In the next installment we will describe a simple but accurate method of measuring the inductance of coils.—Editor.]

JANUARY MEETING OF THE A.I.E.E.

The American Institute of Electrical Engineers held their 328th meeting on January twelfth under the auspices of the Pittsburgh Section of the Traction and Transportation Committee at the Fort Pitt Hotel, Pittsburgh, Pa.

An interesting paper entitled "Regenerative Braking of Electric Vehicles" was presented by R. E. Hellmund of the Westinghouse Electric and Manufacturing Company. This paper presented an exhaustive study of regenerative control as applicable to the various systems of electrical railways; and in view of the wide possibilities which exist for successful regeneration, the subject of regenerative braking is now rapidly assuming considerable commercial importance. It possesses many practical advantages in electric railway work and for heavy railroads, as well as in various other fields, such as steel mills, etc., which cause this subject to be of particular interest to electrical engineers engaged in railway work and other industrial applications of electric power.

THE QUENCHED SPARK GAP.

(*Continued from page 815*)

the same amount inserted in the secondary circuit, multiplied by the square of the ratio of transformation. The opposite holds true in the case of capacity, which is transferred from one circuit to the other by dividing by the ratio squared. Reactance, as stated before, behaves like resistance. Our reactance adjustments can be most conveniently made in the primary side of the transformer.

The condenser C is connected across the secondary terminals of the transformer without any other apparatus. Its capacity may be roughly determined by the usual power relations, assuming the voltage is known, and should be made adjustable.

When the apparatus has been arranged as shown, the primary mains are connected to the transformer and the current indicated on the ammeter noted when Rp has been adjusted to maximum indication. The capacity at C is then increased until the maximum is again obtained and its value noted. This procedure is gone thru for the different capacities and the corresponding ammeter readings entered in a table. Care should be taken that the condenser capacity does not exceed the limiting value set by the equation:—

$$C = \frac{\lambda^2}{3552L};$$

where L represents the primary radio inductance for the wave length to be used. Any excess of this value would not permit of sufficient inductance in the primary of the oscillation transformer to permit of efficient energy transfer to the antenna. The condenser capacity which gives the largest ammeter reading at resonance should be the one used. If the primary of the transformer is provided with taps for power variation, each tap should be measured in terms of resonant condenser capacity and tabulated for reference. It is possible that the reactance in the primary of the transformer of the closed core type will not be needed for some adjustments, but the condensance of the total circuit should be increased so that the adjustments may be made by this means, as greater flexibility is then obtained.

It will be noted that the writer has referred to the closed core transformer as being the best for quenched gap work. This question of difference between the two types of transformer has been disputed for several years and various opinions have

been exprest. The reasons why the author has suggested the use of the closed core type are as follows: In favor of the open core type, it might be said that it possesses the desirable high leakage characteristic and is simple, both in design and construction. The closed core type requires less copper and iron for a given output, and consequently the losses are smaller and it is more efficient. The relative space taken up by the two forms favors the closed core type also. It will be seen that the closed core instrument is to be preferred. However, the open core type can be used, provided a suitable reactance is inserted in the primary to compensate for the leakage reactance of the other type. This is in addition to the adjusting reactance used in the preceding experiment, and can be incorporated in the adjusting reactance itself.

It has been the experience of various engineers working with the quenched gap that a *detuning* of the transformer circuit about 15 per cent off the resonant frequency just determined was desirable in order to obtain a clear note. This may be done later when the gap is put in operation by readjusting the reactance in the primary. An explanation of this detuning process as given by a well-known engineer is somewhat as follows:

Referring to Fig. 2, which represents the variation and phase relations of the current with the various reactance adjustments as abscissae, the heavy dotted line drawn parallel to the Rp axis indicates the zero phase axis. Above this line capacity predominates and the primary current leads, while below it the current lags. It will be observed that the current curve has an asymptote on an axis at right angles to Rp at the resonance point. In other words the current at this point reaches a high value, and is limited only by the resistance of the circuit. This would indicate that the point of exact resonance does not represent a safe working condition owing to the excessive current obtained. Of course this could be controlled by means of resistance, but this would reduce the efficiency of the apparatus and it will be found better to detune from the resonant frequency. The shaded portions of Fig. 2 show the operating regions after this is done.

The question now arises as to the difference between these regions. It will generally be found that operation in the region marked II will give the best results, from the standpoint of spark clarity. From A to B the current will lead, causing a rise of generator voltage because of the rapid reduction of initial gap resistance, due to the fact that currents in this phase relationship cause the armature reaction to aid with greater extent the generated E.M.F. In the region C to D the opposite holds true, *i.e.*, that the voltage will fall as the resistance of the gap drops, resulting in practically a uniform current thru the gap, and a pure note. This is probably the reason why it is better to work above the resonant point rather than on or below it. Experiment under the actual conditions is the only means by which the exact operating point may be determined.

Referring to Fig. 3, it will be seen that the quenched gap G and inductances L_1 and L_2 of the radio circuit have been connected in, and coupled to the antenna circuit. Previously, however, the two radio frequency circuits are tuned to resonance and the coupling adjusted until the two emitted waves lie close together. Call this the critical coupling. Now, using all the gaps at hand, the mains are connected to the primary and the set operated. Allow the gap to operate for about five to ten minutes, in order to complete the chemical reduction in the sparking chamber.

If the gap has not been previously *seasoned*, it will take a longer time for this action to ensue, for the reasons previously pointed out. By listening in on a wave meter, the pitch and clarity of the note may be determined, and when this has been partially cleared the current may be shut off. Now from the table obtained during the resonance adjustment just made on the transformer circuits, find the amount of reactance to be used in series with the primary. Set Rp to this amount and place the set in operation again, listening in on the wave meter (or receiving set). Vary the amount of reactance in series, keeping above the resonance point, until the note is clear and the current in the primary is at a maximum. The coupling may be adjusted at the same time as the reactance exercising care not to deviate from the critical coupling by a large amount. If an integrating wattmeter of the indicating type is at hand, it should be placed in the primary circuit of the transformer and used to determine the point of maximum power. Finally the antenna current is noted and the point at which the primary power or current is maximum, and when the ratio of this power to the radiation current is maximum, the note of the spark clear and the wave lengths not too far apart, the transmitter may be said to be operating at its highest efficiency at the wave length used. This adjustment should be made for all taps on the power variation switch on the primary of the transformer, and the values of the various units tabulated for future reference when it is desired to use less power.

It may be found in reference to the antenna current that the hot-wire type of ammeter is not sufficiently sensitive to follow the changes of current when the quenched gap is used, and the adjustments of coupling, etc., may have to be made slowly in order not to *miss* the maximum. It is suggested that this form of current measurement be replaced with the thermo-junction and milli-voltmeter, calibrated in terms of R.M.S. amperes. The author hopes at some future date to give a more detailed description of this apparatus and some of the results obtained by its use.

By reading carefully the foregoing paragraphs, and also by extending the study of this gap to other available publications there is no doubt that some of the misconceptions concerning the quenched gap may be corrected and it may then enjoy a more extensive use. This gap will not raise the frequency of the spark, nor will it do any other of the astounding and phenomenal things sometimes claimed for it, but it will allow a reduction of decrement of the radiation, at the same time increasing the efficiency of the transmitter and giving the spark a clearer tone.

In order to aid those who have as yet had no experience with quenched gap design or who have met with failure in their previous attempts, the writer has included the design of a small gap suitable for use on a 60 cycle, quarter K.W. closed core transformer having a secondary potential of the order of 10,000 volts or under. In case it is desired to increase the spark frequency and at the same time retain the desirable quenching qualities of the quenched gap, it is recommended that a rotary gap and the quenched gap be connected in series, as has already been suggested by Mr. Blatterman.

Referring to the Fig. 4, the various parts of the gap may be seen. The plates are cut from sheet brass, or cast and trued on a lathe. The general experience, however, will be that it is better to cut them from 1½-inch bar stock, as the chucking is simplified and the waste is not great.

A word might be said in regard to the gaskets. This has been the cause of fail-

ure in a great many quenched gaps on account of leakage. The writer has tried nearly everything in the line of insulating materials and has found that ordinary cardboard, impregnated with an insulating varnish containing rubber, gave the best results and at the same time was much more economical than any of the others. The number to use in each gap of course depends on the thickness of the material employed, and the total voltage to be used in the gap, and can be determined experimentally. In mounting the gap apply sufficient pressure but do not overtax the materials supporting it. The elastic limit of the materials shown in the drawing is great enough, provided reasonable care is exercised in assembling the gap and clamping the plates.

If the note of the gap is not clear after making the adjustments according to the preceding paragraphs, either the gap may be leaking, is too short, or the condensers or the gap may be *brushing*. There should be absolutely no brush discharge around apparatus using a quenched gap. When this condition does exist, it will invariably be found impossible to thoroly clear the note.

The coupling adjustment with the quenched gap is a delicate one and should be made carefully.

In Fig. 5 is shown graphically the general effect of the coupling adjustment on the radiated energy. These curves for the case of a quenched gap and synchronous rotary gap were obtained with the apparatus shown in Fig. 3. The sharp rise to the maximum in the case of the quenched gap is clearly shown. Another point of interest is the increased radiation over that obtained with the rotary. The maximum radiation obtained with the synchronous rotary gap was nearly 4.4 amperes, while that of the quenched transmitter was 50 per cent higher, 6.7 amperes. Decrement readings were made for each coupling adjustment to determine the boundary conditions of operation in order to keep the radiation within the limits defined in the radio legislation. It was found that at about two inches coupling, the quenched gap radiated practically one wave, while for a *condition even approaching this* the coupling with the rotary gap had to be loosened to 4.5 in. This resulted in the antenna current dropping to about 2 amperes, which is very low compared with the 6.6 amperes obtained with the quenched gap.

It is at once apparent from a consideration of the above results that the quenched type of spark transmitter is appreciably more efficient in every respect.

TESTING HIGH VOLTAGES WITH SPARK GAPS.

(*Continued from page 822*)

tive air density should be taken from table below.

Values of relative air density and correponding values of the correction factor are tabulated below. It will be seen that for values above .9, the correction factor does not differ greatly from the relative air density.

The Spark-Over Voltage, for a given gap, decreases with decreasing barometric pressure and increasing temperature. This correction may be considerable at high altitudes.

The spacing at which it is necessary to set a gap to spark over at some required voltage, is found as follows: Divide the required voltage by the correction factor given in Table 4. A new voltage is thus obtained. The spacing on the standard curves obtained from Table 3, corresponding to this new voltage, is the required spacing.

The voltage at which a given gap sparks over is found by taking the voltage corres-

ponding to the spacing from the standard values of Table 3, and multiplying by the correction factor.

TABLE 4.

Air-Density Correction Factors for Sphere Gaps.

Relative air density	Diameter of standard spheres in mm.			
	62.5	125	250	500
0.50	0.547	0.535	0.527	0.519
0.55	0.594	0.583	0.575	0.567
0.60	0.640	0.630	0.623	0.615
0.65	0.686	0.677	0.670	0.663
0.70	0.732	0.724	0.718	0.711
0.75	0.777	0.771	0.766	0.759
0.80	0.821	0.816	0.812	0.807
0.85	0.866	0.862	0.859	0.855
0.90	0.910	0.908	0.906	0.904
0.95	0.956	0.955	0.954	0.952
0.95	0.956	0.955	0.954	0.952
1.00	1.000	1.000	1.000	1.000
1.05	1.044	1.045	1.046	1.048
1.10	1.090	1.092	1.094	1.096

A "SECRET" RADIO SCHOOL.

The "Transmississippi Wireless Telegraph and Wireless Telephone School" was incorporated with a capital stock of $20,000 by Sanford Schonbrunn, Roy A. Leslie and Henry A. Meyer to "teach wireless telegraphy and telephony by a *secret process.*"

EXPERIMENTAL CHEMISTRY.

(*Continued from page 826*)

It is used:—

[1] As a basis of various inks, as India ink and printers' ink, as well as an ingredient of black paint, etc.

[2] Also as an ingredient of stove-polish.

EXPERIMENT NO. 37—

Have lighted a candle, the oil of a kerosene lamp, and the gas of a fish-tail burner, also of a Bunsen burner. Take a piece of glass and hold it across the flame of the candle and notice if any deposit is left on the glass. In the same manner hold a piece of glass over the kerosene lamp, over the fish-tail burner, and the Bunsen burner.

Do these substances tested contain the same elements? This is ascertained by comparing the results of the products on the glasses.

It will be noticed and remembered that the same element is contained in three different forms—namely, in the case of the candle as a solid; in the kerosene as a liquid, and in the gas emitted from the fish-tail burner, as a gas. The reason no deposit is left from the gas of the Bunsen burner is because there is almost perfect combustion taking place in this case.

The deposit left on all the glasses is called Lampblack.

Coke:—

Coke is a fuel obtained by heating coal in confined places. This is done sometimes in heaps, just as charcoal is made from wood, but more frequently in ovens. It is also a by-product in the manufacture of illuminating gas, remaining in the retort after the volatile portions, which go to make gas, have been driven off by the destructive distillation. Coke is a hard, irregular, brittle and porous solid, having a grayish and sometimes metallic luster. It does not burn so easily as coal and in consequence requires a constant draft of air. Its combustion is accompanied with great heat and but little smoke, which is a highly desirable quality in separating metals from their ores. Also it does not become pasty in the fire and some of the sulfur of the coal is driven off. It is used in metallurgical operations as a

reducing agent. Also in smelting and refining metals from their ores.

EXPERIMENT NO. 38—

With a new set of apparatus used in Experiment 35, and in the place of wood, fill the test tube with finely crushed Soft Coal. Heat as before and record your results. Test the gas at the end of the stricture tube by applying a flame to the end. What were the results? After the heating is complete, examine and see if you can identify the substance left in the test tube. Test the contents of the bottle with both red and blue litmus paper and record your results. The three products of the destructive distillation of coal are [1]a gas; [2] a liquid, and [3] coke, which is left in the test tube in place of the original coal.

Mineral Coal:—

Mineral coal is a compound, especially of carbon or of decomposed woody matter with inflammable substances and hydrogen and oxygen gases. There are two chief varieties of coal [1] Anthracite and [2] Bituminous, and several less important varieties.

[a] Anthracite coal:—This is a very hard, lustrous, and shiny coal, and breaks into lumps. It burns steadily with little or no flame, giving off great heat and requiring a high temperature to set it on fire. It is used very extensively for heating purposes.

[b] Bituminous coal:—Bituminous coal, though still hard, breaks more easily than anthracite. It burns at a much lower temperature than hard coal with a bright yellow flame, giving off less heat and liberating volumes of smoke. It is less rich in carbon than anthracite, but is much richer in hydrocarbons. As it gives up so many gases rich in hydrocarbons, it is used in the manufacture of illuminating gas, and the product of distillation furnishes coke.

Cannel coal is a variety of Bituminous coal, and is so rich in hydrocarbons that it may be lighted with a match. This is a very expensive variety and found in but few localities. On account of the large proportion of volatile matter contained in it, this coal is much used in England for gas making.

Lignite is a brown coal of more recent formation than the previous varieties. It frequently retains the structure of the wood from which it was formed, and contains from 50 to 80 per cent of carbon.

Jet is a variety of brown coal, so compact as to take a fine polish.

Pete and Turf are other varieties of coal and are less pure forms of carbon, being made up of roots of plants, etc.

Formation of Coal:—

The one theory now generally accepted is that the rank and luxuriant vegetation which prevailed during the carboniferous age grew and decayed upon land but slightly raised above the sea; that by slow subsidence this thick layer of vegetable matter sank below the water and became gradually covered with sand, mud, and other mineral sediment; and then, by some slight upheaval of the bottom of the sea or other process, a land surface was once more formed and covered with a dense mass of plants, which in the course of time decayed and became overlaid with silt and sand as before. At length thick masses of stratified matter would accumulate, producing great pressure, and this, acting along with chemical changes, would gradually mineralize the vegetable layers into coal.

EXPERIMENT NO. 39—

Mix 5 grams of Copper oxid [CuO] with 1 gram of powdered charcoal. Pour the mixture into a test tube and arrange the apparatus as shown by Fig. 50, allowing the gas which is liberated when the tube is heated to bubble thru a little limewater, contained in test tube D.

Heat the tube, commencing at the part around the upper part of the mixture, and

...ually moving the flame toward the ... end of the tube. Observe and record the change that takes place in the limewater. Can you remember any other experiment which you performed, that caused a similar change in limewater? By comparing such experiments could you identify this gas as Carbon Dioxid [CO_2]?

EXPERIMENT NO. 40—

Allow the tube heated in the foregoing experiment to cool and when cold pour its contents into a 200 cc. beaker. Let a small stream of water flow into the beaker. What substance is carried away by the water? What is left in the beaker? What element is taken from the Copper Oxid? Assuming that Carbon Monoxid has been liberated, the following would be the equation if the experiment was performed under proper conditions:

$$\underset{\text{Copper Oxid}}{CuO} + \underset{\substack{\text{Charcoal} \\ \text{[Carbon]}}}{C} = \underset{\substack{\text{Carbon} \\ \text{Monoxid}}}{CO} + \underset{\text{Copper}}{Cu}$$

EXPERIMENT NO. 41—

Thoroly mix a little boneblack with some cider vinegar in a small beaker. Fold a filter paper and place it in a funnel. Pour some boneblack on the filter paper and scoop out a hollow in the center of the boneblack. Into this hollow pour the mixture of vinegar and boneblack. Collect the filtrate and note its color. Filter a solution of Copper Sulfate thru boneblack. Can the color be removed from all liquids by filtering them thru boneblack? Try a solution of red ink and water. From these experiments can you form a conclusion why crude sugar is dissolved in water and filtered thru boneblack?

EXPERIMENT NO. 42—

Place a small piece of Ferrous Sulfid in a test tube and add 10 cc. of water and 5 cc. of dilute Sulfuric Acid. Result. Note the odor. When the action becomes vigorous, half fill the tube with boneblack. Shake and observe the odor. If definite results are not obtained cork the tube and if the tube leaks make the opening gas-tight by rubbing vaseline around the opening, and shake thoroly. [Hydrogen Sulfid solution may be used in place of the Ferrous Sulfid and Sulfuric Acid, as these compounds are used to produce Hydrogen Sulfid.]

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Vol. IV Whole No. 48 **CONTENTS FOR APRIL, 1917** **No. 12**

In profound sorrow, we announce the death of our

Mr. Milton Hymes

Secretary, Business and Advertising Manager of the Experimenter Publishing Co., and Secretary of the Electro Importing Co.

Mr. Hymes had just completed an exceedingly successful advertising trip thru the Middle West, visiting Milwaukee, Chicago, Detroit, Toledo, Dayton, Cleveland and Pittsburg. He left the latter city on the evening of February 26th, and was due in New York the following morning, when he met his tragic death in the fearful wreck of the Pennsylvania Railroad near Altoona, Pa., which caused the death of twenty other passengers.

A great deal of the success of "The Electrical Experimenter" is directly due to Mr. Hymes, whose indefatigable zeal and enthusiasm, his unflinching labors and his keen insight in business affairs helped to make the publication one of the greatest of its kind in the country.

In Mr. Hymes "The Electrical Experimenter" has lost one of its most tireless as well as capable workers and to us his untimely death certainly is irreparable.

An upright, fearless man, a devoted son, a faithful husband, a stanch friend and an exceptional business associate, his passing is mourned by hundreds. Though only 28 years old, his charming personality made him scores of friends in electrical and advertising circles and his loss is keenly felt by all.

Milton Hymes will continue to live forever in our hearts.

THE PUBLISHERS.

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H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

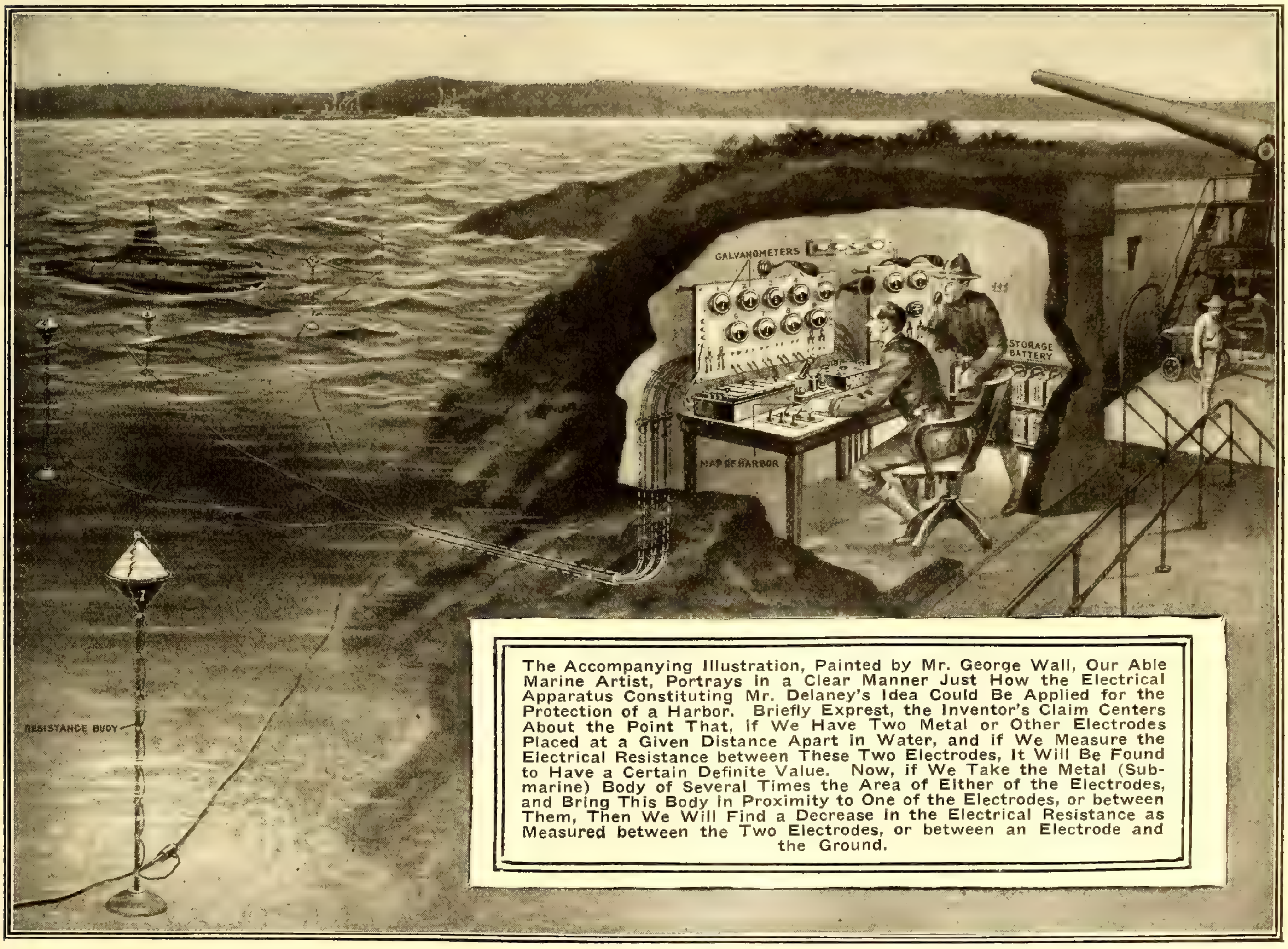
Vol. IV. Whole No. 48 APRIL, 1917 Number 12

Locating Hidden Submarines by Electricity

By H. WINFIELD SECOR

AN extremely interesting and apparently heretofore unthought of electrical scheme of extreme simplicity for the detection and location of submerged metallic bodies, such as submarines or sunken wrecks, has been patented by a well-known American inventor, Mr. Patrick B. Delaney. The accompanying illustration, painted by Mr. George Wall, our able marine artist, portrays in a clear manner just how the electrical apparatus constituting Mr. Delaney's idea could be applied for the protection of a harbor. Briefly exprest, the inventor's claim centers about the point that, if we have two metal or other electrodes placed at a given distance apart in water, and if we measure the electrical resistance between these two electrodes, it will be found to have a certain definite value. If we take a metal (submarine) body of several times the area of either of the electrodes, and bring this body in proximity to one of the electrodes, or between them, then we will find a *decrease* in the electrical resistance as measured between the two electrodes, or between an electrode and the ground.

The illustration here reproduced shows the necessary apparatus as it might be installed in a suitably protected bomb-proof room in a fort or other suitable location, and as the officer in charge of this work would have before him a map of the area thus equipt with Delaney *electrode-buoys*, it would be a simple matter for him to quickly locate the position of an enemy submarine or other metallic body such as a wreck, et cetera.



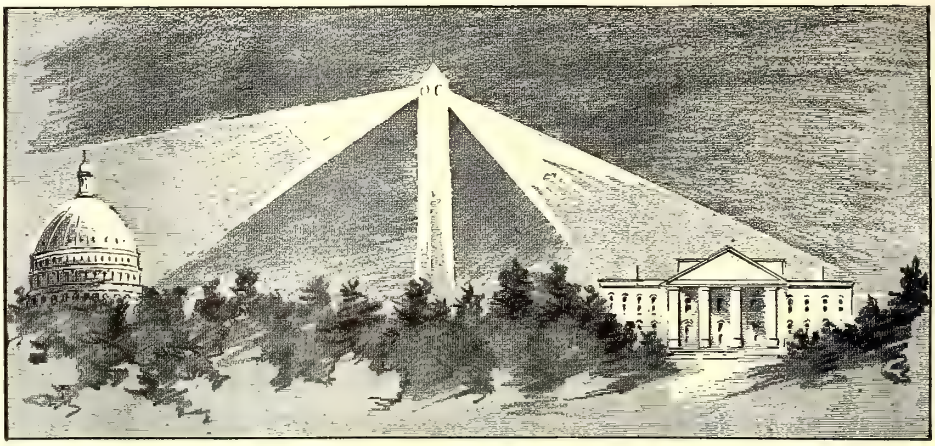
The Accompanying Illustration, Painted by Mr. George Wall, Our Able Marine Artist, Portrays in a Clear Manner Just How the Electrical Apparatus Constituting Mr. Delaney's Idea Could Be Applied for the Protection of a Harbor. Briefly Exprest, the Inventor's Claim Centers About the Point That, if We Have Two Metal or Other Electrodes Placed at a Given Distance Apart in Water, and if We Measure the Electrical Resistance between These Two Electrodes, It Will Be Found to Have a Certain Definite Value. Now, if We Take the Metal (Submarine) Body of Several Times the Area of Either of the Electrodes, and Bring This Body in Proximity to One of the Electrodes, or between Them, Then We Will Find a Decrease in the Electrical Resistance as Measured between the Two Electrodes, or between an Electrode and the Ground.

It should be borne in mind also, that practically all American harbors are plentifully sprinkled with special *electric mines,* the position of each mine being accurately known and plotted on a map in possession of an officer on shore. Before him there is an electrical switch and signal board, with a contact on it for each mine by number. As soon as a ship approaches one of these mines the officer has but to press an electric

SCHEME TO LIGHT WASHINGTON MONUMENT, CAPITOL AND WHITE HOUSE WITH ONE SEARCHLIGHT.

A NOVEL patent has recently been issued to Mr. Frank H. Ellison whereby it is proposed to erect suitable large size mirrors at the top of the Washington Monument in Washington, D.C., so that a powerful searchlight beam projected from the Hotel Raleigh could, by means of the doubly reflected beams from the mirrors, be caused to illuminate the dome of the Capitol as well as the White House simultaneously. The idea involved is apparently to increase the illuminating efficiency.

The accompanying illustration shows the idea in a clear manner and the inventor certainly deserves credit, as it is the first time to our knowledge that such a double reflecting scheme has been proposed on such a large scale. The patentee has covered the details for the construction of the mirror supporting frames and also the angle they shall take with respect to the buildings to be lighted and also with respect to the walls of the Washington Monument. This scheme would seem applicable to many other illuminating problems where such a high structure as the Washington Monument is available on which to mount suitable mirrors or reflectors. The searchlight beam proper is not shown in the illustration here reproduced, but would be projected toward the Monument approximately from the position occupied by the reader of this article.



A Novel Scheme Worked Out by an Inventor of Washington, D.C., whereby a Single Searchlight and Two Large Mirrors Will Serve to Illuminate the White House and Capitol.

U-BOAT USED RADIO DECOY.

A recent dispatch from Amsterdam states that German submarines are now sending out S O S wireless signals to lure British vessels to destruction.

The *Telegraaf* learns from an officer of a large steamer of an important Dutch line that while on a voyage from the Dutch East Indies he received while in the Bay of Biscay an S O S message. The ship immediately rushed to the place indicated and found a German submarine, which was not in distress. The captain of the submarine exprest regret that it was a Dutch and not a British ship that had heard the call.

JAPAN'S NEW RADIO WITH UNITED STATES.

The efficiency of Japan's new wireless station, which is now in regular communication with the United States by way of Hawaii, was strikingly shown by its recent picking up of messages sent from Northern Germany and from some other continental wireless station. The Japanese station, which is situated at Funabashi, ten miles east of Tokio, was receiving a message from Hawaii when it picked up several cipher messages addressed to E. G. C., which stands for Madrid, which were being sent by some powerful station some 6,000 miles away.

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button and the ship will be blown to pieces. These mines are so powerful that even tho a vessel might be some distance from them, they will be thoroly shattered and put out of commission. It is also possible in the latest type of electric mines to so control them from a fort on shore that they may be exploded automatically, so that ship will detonate the mine by simply striking against, but if a neutral vessel had to pass thru this mine field, then it is possible to open the proper circuits to the mines, so that it will not be detonated by a ship coming in contact with it.

The apparatus required for the application of Mr. Delaney's most ingenious and extremely simple yet important invention, are shown in the accompanying illustration and comprises principally a source of electrical energy of low potential, such as a storage battery and a suitable set of measuring instruments for determining the electrical resistance between any two of the submarine electrode-buoys. One side of the resistance test-circuit, which includes a very sensitive galvanometer and a source of current, is grounded and the resistance may be measured from the water to a submerged electrode-buoy or the resistance between any two or more buoys may be measured. A Wheatstone bridge is shown as part of the equipment and, of course, an operating room for this apparatus would be equipt with a loud speaking telephone, so that information could be freely exchanged between this room and other parts of the fortification. It would be very feasible to combine this apparatus in the same room with the electrical control switchboard for detonating the submerged mines as previously mentioned.

The inventor claims that with a suitable arrangement of galvanometers and a proper arrangement of electrode-buoys anchored at different depths, it is readily possible to quickly and accurately establish the approximate location of submarines or other metallic bodies brought into proximity with one of the buoys, and that it is also possible by such a scheme to determine the direction in which the object is moving and its course. The application of this arrangement has here been shown as applied to a harbor with a detecting station on shore, but it is obvious that the indicating instruments may be located on shipboard when desirable.

It is indeed remarkable that such a simple method of detecting submerged metallic bodies should not have been promulgated or proposed by electricians before, and great credit is due Mr. Delaney for bringing out this practical and efficient electrical submarine detection scheme at this time.

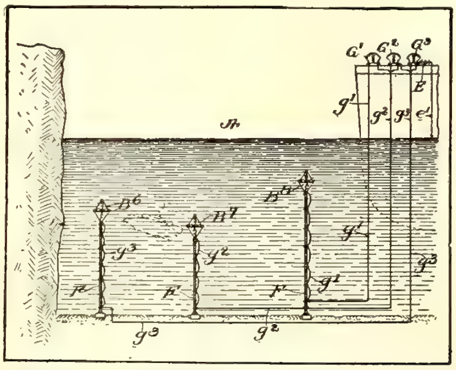


Diagram Showing How the Delaney Electrode-buoys May Be Connected Up, Each to a Distinct and Independent Galvanometer.

WHAT THE U.S. NAVY OFFERS TO YOUNG MEN.

Uncle Sam's Navy offers a wide variety of industrial courses to ambitious young men. If the recruit has had some training or experience in electricity, he may enter either the general or the radio classes of the electrical schools, one at the Brooklyn and the other at the Mare Island Navy Yard. The great advantages of these courses are discust in the annual report of the Secretary of the Navy. Here the course of instruction comprises machine-shop work, reciprocating steam engines, steam-turbine engines, internal-combustion engines, magnetism and electricity, dynamos, motor generators, alternating currents, batteries, and the like. In the radio group there is thoro practise in the radio mechanism for receiving and sending. In the Artificer School at the Norfolk Navy Yard men are taught to be shipwrights, ship fitters, blacksmiths, painters, and plumbers. Both at Newport, R.I., and San Francisco are yeomanry schools, where the men are perfected for the clerical work of the Navy to become expert stenographers, typewriters, bookkeepers, etc.

An attractive line in the Navy is the Hospital Corps, with schools at Newport, R.I., and San Francisco. Not a few men have gone out of these schools after their Navy service to make good doctors in civil life, after the thoro training received in anatomy and physiology, nursing, first aid, and emergency surgery, hygiene and sanitation, pharmacy, materia medica, toxicology, chemistry, and the like. Music is essential to vary the secluded life afloat, and boys with musical talent are instructed in the schools at Norfolk and San Francisco. The machinist school at Charleston is open to men who show themselves apt in mechanical work. The coppersmith school is located also at Charleston. The two commissary schools are at San Francisco and Newport. At Pensacola every three months a class of 16 enlisted men, selected by the commander in chief of the Atlantic Fleet, is trained for an 18 months' course in aeronautics. The course is divided into two classes—mechanics and flying. The men are afterwards transferred to general service and are entitled to additional pay of 50 per cent while detailed to the duty of actual flying. The seaman gunners' school is located at Newport where a special study of the torpedo is made.

New Automatic Electric Buoy Never Fails

NIGHT covers the ocean. A terrific gale sweeps the waters and thru the inky blackness a ship is struggling slowly to find its way. The captain, braving the storm, is on the bridge. He knows that the vessel and all the lives entrusted to him are in greatest danger. Not only on account of the gale, but also because the ship is navigating in highly dangerous, rocky waters. At any moment the vessel may be thrown helpless against a deserted, uninhabited shore.

No light buoys show her the way. It was found impossible to place gas light buoys near these rocks. The gas mantles would not withstand the shocks of the heavy waves which rush with terrible force against the rocky shores. And who shall keep the gas light buoys in operation? Who shall replace here on this deserted coast the fuel and broken burners? So the known danger remained to navigation for many years.

But look! What is this? A red light suddenly flashes over the rolling and thundering waters. It disappears for a moment and then it flashes up again, and again. And over there another one in green. Red and green. Again and again. The passengers stare with surprise at the mysterious, silent lights. They flash and flash. But the officers on the bridge exchange looks of relief and satisfaction.

"Full Steam Ahead!" goes the captain's command into the engine room and the slowly wavering giant starts again to tremble with her powerful effort to plow thru the rough sea. "Automatic Electric Light Buoys" is the succinct answer the captain gives to inquiring passengers. But the ship is saved and the passengers free from danger while the silent, flashing lights slowly disappear in the far distance behind.

* * * *

The *Automatic Electric Light Buoy* is one of the latest and most ingenious inventions of Mr. H. Hartman, a well-known civil engineer of New York, whose electric submarine camera and speaking clock have been described in the December and January numbers of THE ELECTRICAL EXPERIMENTER.

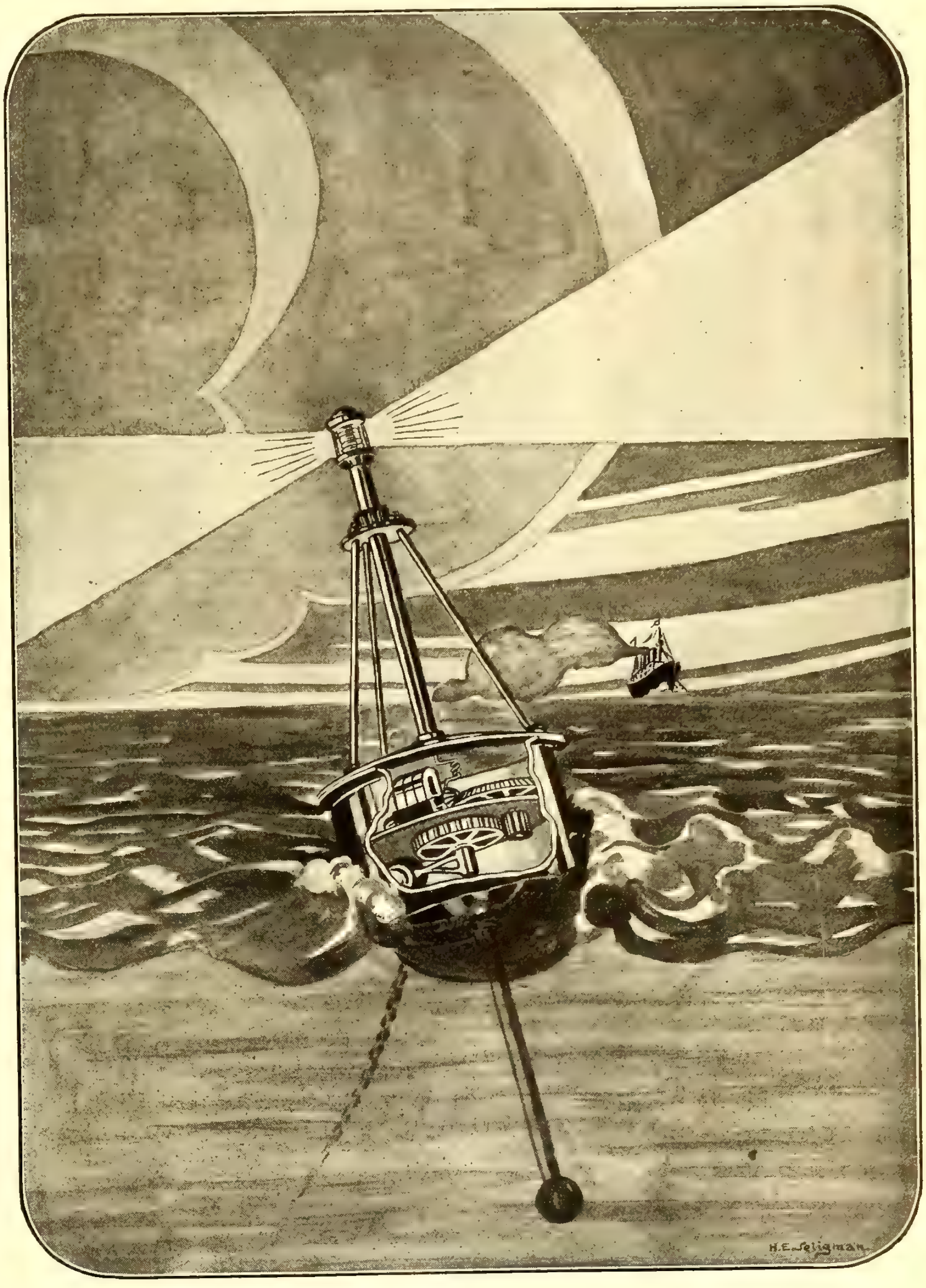
His new electric light buoy produces its own electric current for illumination thru the motion of the waves. It does this in the most simple and ingenious way, avoiding every complicated mechanism which might easily get out of order. It has no storage battery, no automatic cut-out, no relay switch and no *filament lamp* which would break thru the rocking of the buoy in heavy seas.

This electric light buoy has simply a vertical shaft, journaled at both ends in ball bearings, and a bracket which carries a heavy weight consisting of an iron ball, which will always swing by gravity according to any inclination of the buoy when the same is rocked by the waves, turning thereby the vertical shaft more or less. The turning motion of this shaft is increased and transmitted by means of gears to a special magneto at a ratio of say 40 to 1, so that the magneto would make 40 revolutions for each full revolution of the vertical shaft or 10 revolutions for a quarter turn of the same in either direction.

The alternating current of low voltage thus produced by the magneto passes thru the primary winding of an induction coil, which transforms the same into a current of several thousand volts which would give for instance a spark from 1" to 2" or more. One pole of the secondary winding of this induction coil is grounded to the steel body of the buoy, while the second pole is connected by means of a heavily rubber-insulated wire thru the hollow tube of the superstructure of the buoy, with a special lamp which is constructed on the principle of the well-known *Geissler tubes*, becoming highly luminous as soon as a current of high potential passes thru them.

The particular construction of this lamp is kept secret to a certain extent but this much is known: that it consists of a long tube of about 1/4" dia., made of glass which contains certain metallic salts and which is wound into a spiral of 1" dia., by approximately 6" length. Thus the luminous element is highly concentrated and to increase the light a second glass tube, sealed at both ends and covered inside with reflecting, non-conductive material, is arranged within said spiral, acting as a reflector in all directions. This spiral lamp hangs vertically with both ends on elastic springs, which are at the same time acting as conductors and shock-absorbers, within an outer larger lamp casing, consisting mainly of the generally known and used prismatic glass cylinder, sealed water-tight at both ends by bronze bushings, as used on ships, boats, gas-light buoys, etc.

This electric lamp gives from 5 to 15 C.P., according to size and current, and tests have proven that it can be seen at night for several miles. The lamp can be made to give white, red or green light and is about 5 to 7 feet above the water-line. At the bottom of the buoy a hollow, tubular shaft extends into the water, which keeps the buoy in a vertical position when there is no motion of the water.



Remarkable New Electric Buoy which, when Rocked by the Waves, Develops Its Own Electrical Energy to Light a Special Vacuum Tube Lamp, Having No Filament. The Lamp Will Last as Long as the Dynamo and Its Inventor Claims that This Buoy Will Care for Itself for Months at a Stretch.

Referring to the illustration, we show one of these automatic electric light buoys

(*Continued on page 939*)

The Automatic Restaurant

ELECTRICITY finds many diversified applications in modern hotel and restaurant service but the greatest of all electrical dreams has come into actual existence in the Automat Restaurants. In the Automat, let it be known, you must wait on yourself. On the other hand you are not under the constant glare of a hard-shell garçon who is forever looking for the inevitable tip. Several of the larger American cities, including New York and Philadelphia, as well as a number of European cities, now have these automatic restaurants.

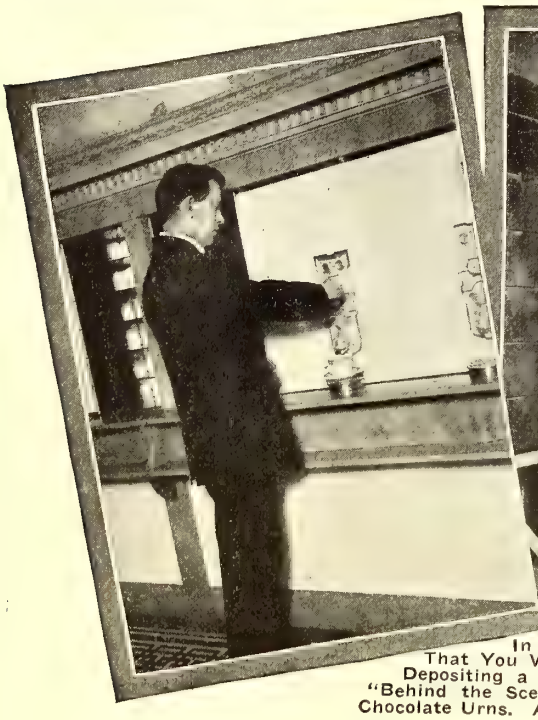
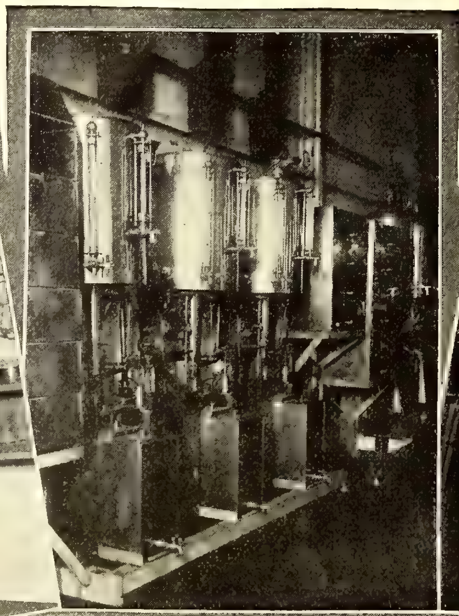
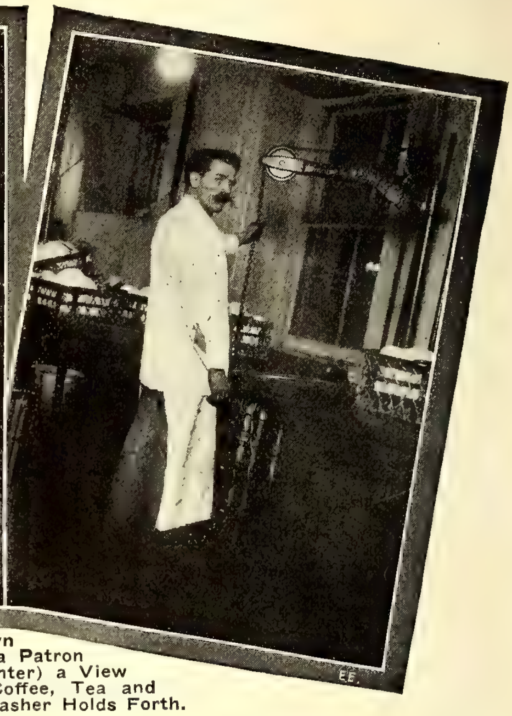
If you have never patronized one of these waiter-*less* food emporiums de luxe, you would most probably approach the entrance on your first visit, with a large size doubt registered in your mind, as did the writer of this article, as to the quality and quantity of the food —not to mention the act of juggling a plate of beans in one hand and a cup of coffee in the other, while you one-stept to a table.

A visit to one of these restaurants proved a revelation. Firstly we find that people of all classes dine here —doctors, lawyers, merchants, shoppers, actors, actresses, et cetra. As you enter the Automat make sure that your supply of nickels is generous. If not the young lady cashier will cheerfully shell out twenty buffalos for a green-back, and start you on your way.

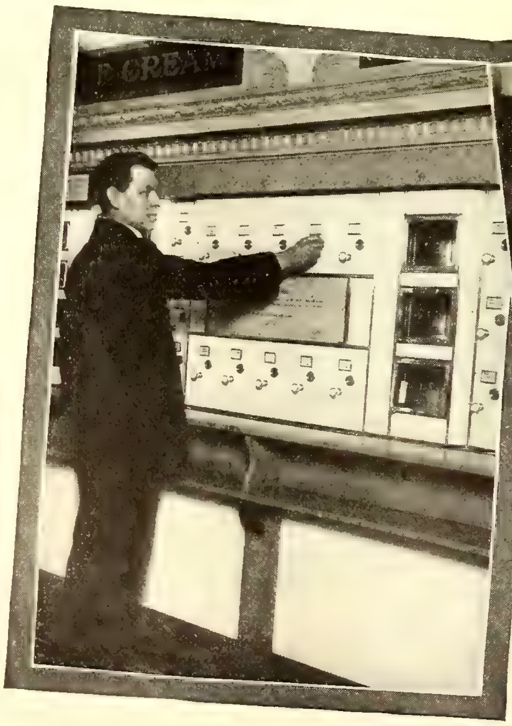
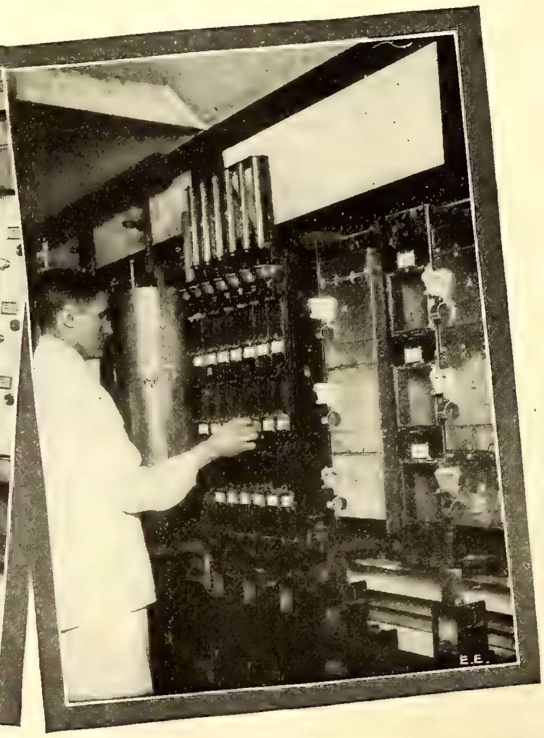
The hot and cold dishes are found in individual groups, properly labeled, so that you soon locate the pie division as well as the soup, sandwich, pastry, coffee, tea and chocolate, and special order sections. These, and many more are distributed along the walls of the restaurant, with the tables occupying the floor except for a space of about six feet in front of the food machines, thus giving free accessibility.

The machines are practically all electrically operated, their functions being performed automatically as soon as a coin is inserted in the slot and the knob on the side is turned. This causes the small glass door in front of the piece of pie, for instance, to become released. You simply push the door up and remove the plate containing the pie. Americans are notorious pie eaters, but don't entertain the rash idea that you can waltz up to one of these mute waiters and mulct a *special* cut of your favorite pie from out of one of its five specimens exhibited. It simply can't be did—Oscar! Why? Oh, just because the head chef has invented a pie cutting machine of deadly accuracy and it cuts five sectors of the luscious mince, each sector having a guaranteed angularity of 72 degrees — no more—no less. But the pie *is* good—ask us—we sampled it.

While we common humans will probably never attain such proficiency in the art of food juggling that we can move down the center aisle with five beef stews in one hand and six cups of coffee in the other it is interesting to study the modus (*Continued on page 939*)

In the Automatic Restaurant Be It Known That You Wait On Yourself. At Left We See a Patron Depositing a Jitney For a Cup of Coffee and (Center) a View "Behind the Scenes," Showing the Always Ready Coffee, Tea and Chocolate Urns. At Right—Where the Electric Dish Washer Holds Forth.

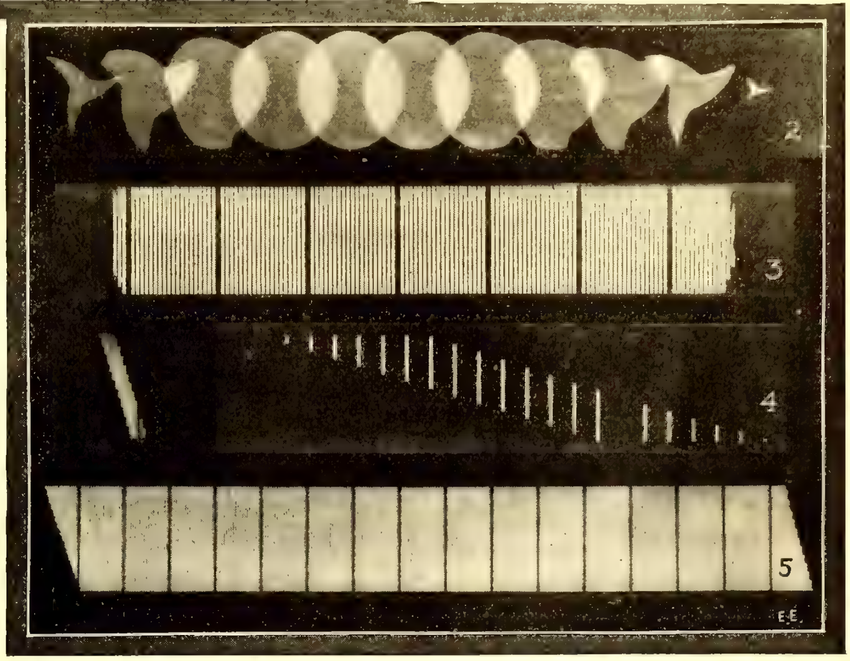



Front and Rear Views of the Automatic "Special Order" Board. Patron (Left) Inserts Coins and Receives Oven Check; Chef (Right) Sees Order Flashed Up; When Ready He Puts It In Proper Oven (At Extreme Right), from Which the Patron Removes It.

Timing Camera-Shutter Movements Electrically

AN ordinary arc lamp and a small specially governed motor have enabled one of the leading camera manufacturers to develop in its research laboratory a simple camera-shutter testing outfit which projects images of the shutter opening at intervals of a thousandth of a second on a strip of motion-picture film, with exposures for each image of only *one thirty-thousandth of a second;* a period of time so infinitesimal that one's conception of it is at the best vague and undefined. In other words, one can get a clear-cut picture record of the shutter aperture every one-thousandth of a second standing still, so to speak, just as one would obtain a snap-shot of a slow-moving object. With such a record the rate of opening and closing of the shutter and the shutter efficiency can be accurately determined and thus improvements in design made whenever possible.

Fig. 1 (Left)—A Simple Motor-Operated Camera-Shutter Testing Outfit Which Shows at Intervals of a Thousandth of a Second the Shutter Apertures With Exposures of Only One-Thirty-Thousandth Second. This Remarkable Scientific Apparatus Enables Camera Manufacturers to Readily and Accurately Determine the Weak Points of Their Shutters, So That Every Part and Function Shall Become a Matter of Standardization.



Figs. 2, 3, 4 and 5 (Below)—Images of "Between-the-Lens" and "Focal-Plane" Camera-Shutter Openings. Each Image Represents the Stage of Opening at a Certain Thousandth-Second Interval. Once Upon a Time the Camera Man Told Us a Shutter worked at 1/1000 of a Second and We Had to Believe Him!

The assembled apparatus is shown in Fig. 1 mounted on a cast-iron base. The arc lamp is enclosed in an ordinary projection lantern, the condenser of which focuses an image of the arc-light crater on the surface of each of twenty small mirrors as they are rotated and which are mounted on the rim of a wheel as shown, which is revolved at a speed of 50 revolutions per second by a specially governed electric motor. The light which is reflected passes thru a simple lens, back of which is placed the shutter to be tested. An image of the shutter aperture is then formed by a small camera lens on the rim of an aluminum wheel, 12 inches in diameter, around which is fastened a band of motion-picture film. The motion-picture wheel is turned by a hand crank and is enclosed in a light-tight box which can be readily removed and taken to a dark room for loading and development.

Since the wheel containing the mirrors rotates fifty times a second and there are twenty mirrors, there are 1,000 interruptions of the arc lamp beam per second. The light from the lantern passes thru a narrow vertical slit before impinging on the mirrors. This slit reduces the angular width of the light flashed thru the shutter to one-thirtieth of that of the angle subtended by one mirror. The time of exposure is, therefore, one thirty-thousandth of a second and a flash is made every one-thousandth of a second.

The results of tests on *between-the-lens* and *focal-plane* shutters are very clearly shown in the photographic records illustrated in Figs. 2, 3, 4 and 5. Fig. 2 is especially interesting since it shows the positions of a between-the-lens shutter set for an exposure of 1/100 second at various stages of opening and closing and records accurately to within one-thousandth of a second the period of full aperture. As can be seen four one-thousandths of a second were required to come to a full opening and three one-thousandths of a second to close while the leaves were fully open for four one-thousandths of a second. The record also shows that altho nominally open for one-hundredth second the shutter was actually open eleven one-thousandths second.

When it comes to recording the speed of shutters open for one-tenth, one-fifth and one-half second, the image on the film is narrowed down by means of a slit inserted in front of the box in which the film is enclosed. This is done because there are only three feet of film and only about fifty images can be taken without serious overlapping. To facilitate the counting of the hundreds of images obtained at the lower speeds one mirror is painted black; thus the images are given in blocks of twenty with one blank as shown in Fig. 3, which illustrates images taken with a between-the-lens shutter set for an opening at one-fifth second. The records shown in Figs. 4 and 5 were taken with a focal-plane shutter set for a short and long opening respectively. By drawing a straight line at right angles to the slit images shown in Fig. 4 the number of points at which the line is cut by the slits determines the extreme number of thousandths of a second the slit of the shutter is passing across a given point on the plate. In this case the line intersects eight slit images, showing the total exposure is eight one-thousandths of a second.

PRESIDENT WILSON PAYS TRIBUTE TO THOMAS EDISON

In excellent health, Thomas A. Edison celebrated his seventieth birthday on February eleventh. On February tenth, a testimonial banquet was given to him at which a letter from President Wilson regretting his inability to be present excited an impressive demonstration of patriotism by officials and employees of the Edison affiliated industries.

"I wish with all my heart that I might be present to take part in celebrating Mr. Edison's seventieth birthday," President Wilson wrote.

"It would be a real pleasure to be able to say in public with what deep and genuine admiration I have followed his remarkable career of achievement. I was an undergraduate at the university when his first inventions captured the imagination of the world, and ever since then I have retained the sense of magic which what he did then created in my mind.

"He seems always to have been in the special confidence of nature herself. His career already has made an indelible impression on the history of applied science, and I hope that he has many years yet before him in which to make his record still more remarkable."

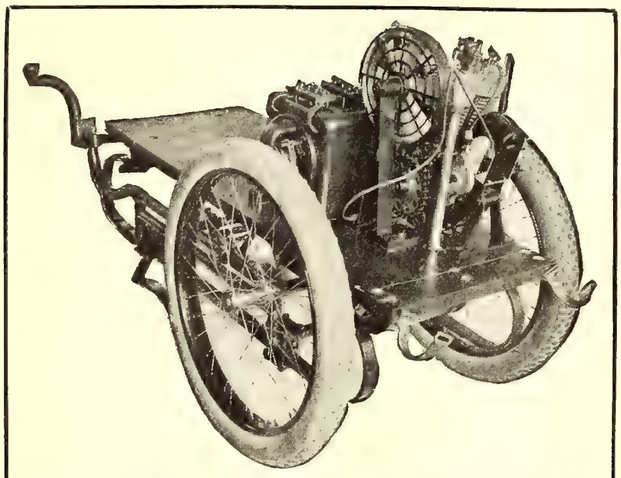
THE "GROWTH" OF IRON.

In the course of a recent address before the South Staffordshire Iron and Steel Institute, Prof. H. C. H. Carpenter gave some interesting examples of the growth of cast-iron. A cast-iron steam turbine case has been known to grow 7 per cent, which naturally had a most pre-judicial effect on its efficiency; and other troubles, such as the seizing of piston heads have been attributed to the same cause. The phenomena of growth appears to be due to the action of silicon, present as silicid, at the same time as free grafite. When iron containing these ingredients is heated oxidising gases penetrate into and gradually attack the metal chemically, causing it to swell. For many purposes such as for steam valves and turbines, it is, therefore, desirable to avoid the use of cast-iron, cast-steel being now substituted.—*The Electrician.*

Londoners have by now become familiar with lighting restrictions and the advice not to waste electricity widely advertised on hoardings. They have not, however, yet had to suffer the restrictions now being imposed in Paris. According to the *Yorkshire Post,* the stopping of electric elevators and the rationing of light in apartments are now under consideration in that city.

Motorcycle Wireless Telephone Outfit

OUR front cover illustration shows a practical possibility in a wireless telephone set mounted on a motorcycle for military requirements, the motorcyclist here being in radiophonic communication with a military aeroplane. While there are a number of motorcycle radio-telegraphic sets in use by the United States Signal Corps and also by foreign armies, these usually require considerable space and necessitate the using of from two to three motorcycle units to transport the complete equipment, which comprises an engine-dynamo cycle of the type here illustrated, a second cycle unit to carry the wireless receiving apparatus, etc., and a third cycle to care for the collapsible aerial mast and wires.



View of Engine and Generator on Motorcycle Unit of Portable Military Wireless Outfit, as Used by U. S. Signal Corps.

Having in mind the extreme compactness of the modern wireless telephone equipment of the de Forest type as is now available and which is capable of transmitting speech from fifty to one hundred miles with a very small amount of current, we have endeavored to bring out on the cover illustration the practical outcome of suitably combining such a radiophone outfit with the motorcycle engine unit, so as to require the minimum of space for the whole outfit, even to the aerial.

The illustration shows how the radio-telephone motorcyclist is enabled to quickly set up his aerial in order to communicate with headquarters or with aeroplanes equipt with radio apparatus. It will be noted that the rear wheel of the motorcycle is revolving, the frame, of course, being supported sufficiently high above the ground and the engine power being used for driving a small electric generator mounted integral with the balance of the motorcycle machinery, with the current from this generator used to energize the radiotelephone set, which might be of the vacuum tube type, for instance.

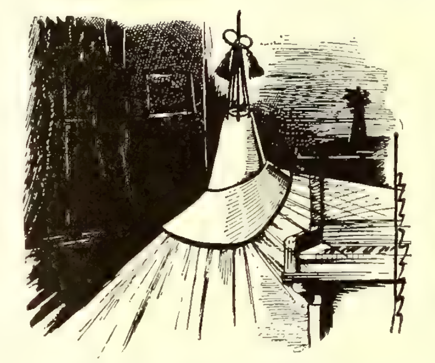
The aluminum collapsible aerial mast is only about five feet high, ordinarily, and telescopes similar to a fishing rod, it being made so as to weigh not more than two pounds. As a matter of fact, some have already been made weighing no more. The aerial itself is also made of thin aluminum wire and is the latest spiral aerial construction interlaced with silk cord, which will make the aerial collapsible also, folding together and taking up very little room when not in use. The entire weight of the aerial is not more than two pounds complete.

The ground wire connects to an aluminum tube tapt at the head for connection purposes, and this is driven in moist ground or earth, this piece not weighing more than about 4 to 5 ozs. The radio outfit itself is attached rigidly to the rear of the motorcycle, behind the saddle, and this outfit does not weigh more than about 12 pounds. For motorcycle purposes it could undoubtedly be made to weigh less by having the box of aluminum sheeting, the weight in this case being not more than four to five pounds.

There should not be any reason why the complete outfit, including putting up aerial, starting generator, testing, etc., should take more than one and one-half minutes from the time of dismounting. There may be some small details which have not been worked out as yet, but they could probably be taken care of without much trouble by the radio engineer of to-day.

"ANTI-ZEPP" SHADES FOR ENGLISH HOMES.

The English lighgting regulations which are now being enforced with considerable rigor have given rise to a demand for shades which will effectually meet the conditions without shutting off more light than is absolutely necessary, says *The Electrician*, London. In order to fill this demand an English manufacturer has put on the market a series of cardboard lamp shades with special features which commend them for general use. These shades, instead of being fixt to the lampholder, are held by cords which are tied to the flexible wire above the lamp at the height necessary to screen the rays from the window. Different sizes and shapes of shade are available, so that their adjustability to all conditions is complete. One form is made with a wide collar shallow towards one side and deep towards the other, so that windows may be fully protected without shutting off much light from the remainder of the room. The collars may also be obtained separately for fixing onto the shades of the other patterns. All these shades are made in various tints, such as dark green, pink, brown, etc.



In "Dear Old Lunnon" It Is Now the Caper to Use Anti-Zepp Shades on All Electric Lights. These Deflect the Light Away from the Windows in the Manner Shown. We Wonder That Liza Will Stand for Such Lime-Light Publicity in Her Own Parlor. Eh, 'Arry?

ELECTROPLATING PLUS.

By Thos. W. Benson.

Electroplating plus machine accuracy is obtained by the use of a new electroplating machine that accomplishes mechanically all operations performed by manual means in the common *still* process of plating. The machine shown in the attached illustration removes to a great extent the human factor in plating operations, which is naturally a great improvement in itself, regardless of the other advantages of the machine as regards more uniform deposits.

The machine is far from being complicated and its mode of operation is obvious. The tanks containing the cleaning, rinsing, dipping and plating solutions are arranged in an oval some thirty feet long. The articles to be plated are past from one bath to the other by means of cam actuated rods instead of by hand. Accurate timing of the plating is obtained by varying the speed of the endless chain that carries the rods, thus giving perfectly uniform deposits.

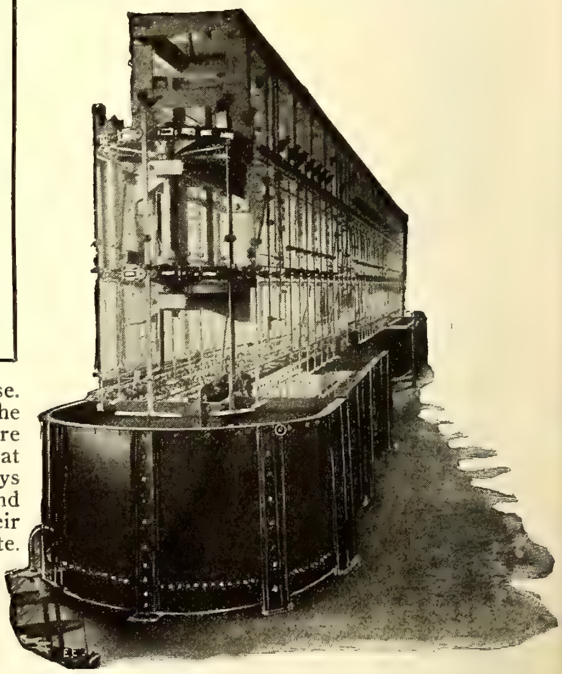
The articles to be plated are hung on racks as shown in the foreground and attached to the rods. After making one complete circuit of the tanks and returning to the starting point the plating is completed. For all ordinary work it takes about one hour for a complete circuit of the tanks; higher speeds would naturally give a lighter deposit, while lower speeds give a heavy deposit on the articles.

It requires but 1 H.P. to operate the machine, which can be easily installed in existing plating plants with a minimum expense of time and labor.

The machine may be adopted to special purposes by a modification of the cam mechanism and the number of tanks. This being made possible by the standardization of all parts.

In addition to the time saved by this machine in transferring the articles from one bath to another, it likewise allows of higher current densities being used without burning the deposit. This is due to the constant agitation of the plating solution by the moving racks.

Altho intended expressly for electroplating it seems highly probable that with modifications it could be used in various other lines, such as cleaning and lacquering small brass parts, or bleaching and dying yarn and similar products.



This Monster Electro-Plating Machine Does Everything but Think. The Articles to Be Plated Are Suspended on Racks Which Move In and Out of the Different Baths Automatically.

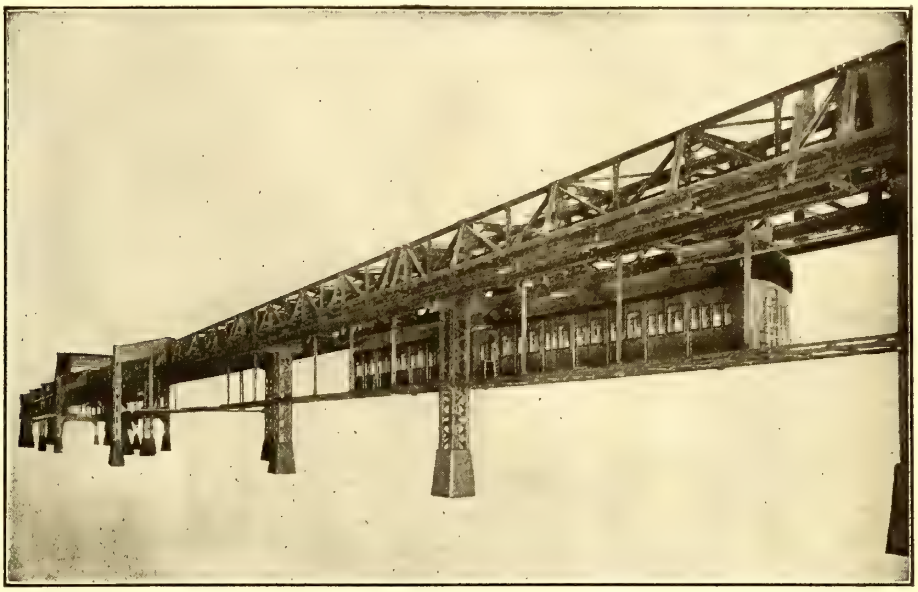
The device marks another important step forward and illustrates in a marked manner the trend of modern industry toward simplified processes and the elimination of time losses.

New Suspended Elevated Railway System

WHILE we are accustomed to seeing the ordinary elevated railway system as installed in many large American cities, such as New York, Boston and Philadelphia, we are inclined to stop and blink our eyes a moment when the proposal is made that instead of having the cars run along on top of the rails, that they be suspended downward from the rails with the wheels and motors secured to the roofs of the cars. A similar system has been in use in Germany for a number of years and possesses many marked advantages, one in particular being that the cars can negotiate or swing around sharp curves much easier and more freely, as well as more noiselessly, than in the usual elevated railway system with which we are familiar.

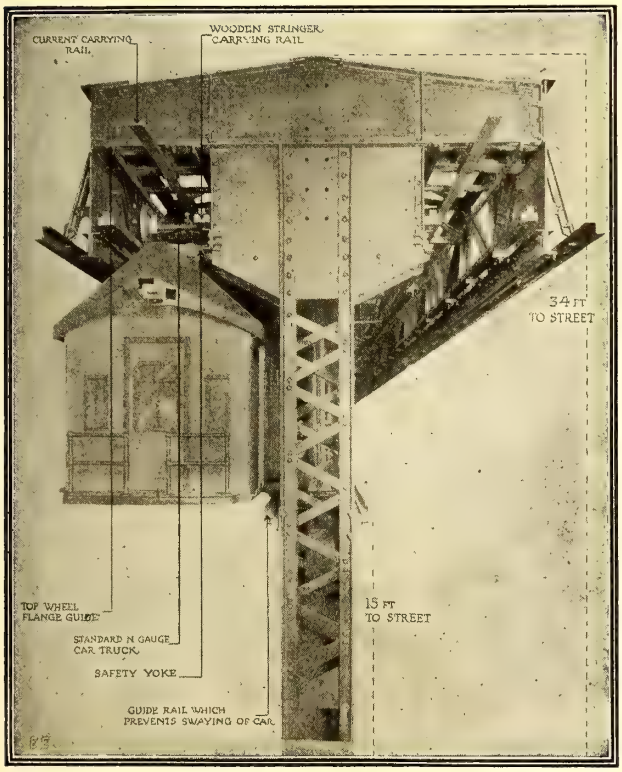
The newly proposed inverted, electric elevated railway system illustrated by the accompanying views is known as the Strauss system. The promulgators of this new railway claim many advantages for their design of railway among which we find the following:

To begin with the Strauss inverted elevated railway does not occupy as much space as the usual elevated system in the street, which is a very important consideration, of course; the new system providing for the suspension of the cars from standard narrow gage trucks that are run on two rails in such a manner that should the trucks or the connection between car and truck fail, the car cannot drop to the ground. Moreover, the track supporting system is of the single post type with provision for a double track system, which effects a maximum economy of street space and particularly, a minimum darkening of the streets and also the smallest possible property damage.



Appearance of New Suspended Elevated Railway System Developed by an American Engineer. Many Distinct Advantages Are Claimed for This Design, Including Lower First Cost, Greater Accessibility to Passengers, Freer Locomotion, (Particularly Around Curves) and Less Darkening of Streets.

The cars are prevented from oscillating by means of special shoes on the bottom of the car, which ride on a guide rail that extends from post to post. The motion of the car is claimed to be smooth, steady and rapid. The sectional view here presented shows how the electric current is fed to the moving cars thru an insulated third rail above the cars, and which construction has the distinct advantage that in case of an accident or a blockade, when the passengers might have to leave the cars and walk along the guide rail to the nearest column, down which they could descend to the street, there would be no danger from a live third rail, as is the case with the present elevated railway systems.



Sectional View of New Suspended Elevated Railway with Single Column Supports. The Electric Motors Are Mounted on Top of the Cars Instead of Underneath Them. The Live "Third" Rail Is Above the Car, Not Beside It.

The track wheels of the cars are flanged and are effectively prevented from running off the main rails by the auxiliary guides, as clearly shown in the sectional view. The inventors of this inverted electric railway also claim that they have provided for the practical elimination of all ordinary noises. This is a very interesting consideration and among the methods by which the engineers intend using this system to accomplish this end are the following:—first by the nature of the track supports which eliminates ties or the ordinary tie floor; by interposing between the track supports and the steel structure, sound deadening material, which is possible in this design owing to the fact that such material will not be exposed to the weather; by filling in the supporting posts with concrete; by the use of a silent wheel, which is said to have seen long use on railways in Russia and finally by the proper enclosure of the driving mechanism.

There are many other advantages claimed for this novel arrangement. The inventors mention that passengers would have to climb 9 feet less than ordinarily required in other elevator structures to reach the car entrance platforms.

No less important is the provision for the loading and unloading of passengers. In the Strauss system there are separate entrance and exit platforms at each station, so that the passengers *entering* do not encounter those *leaving* the cars. This not only prevents confusion, but greatly reduces the time of loading and unloading, which is now one of the principal causes of delay in all city traction systems.

The above features, together with the small space taken in the city streets, i.e., single line of posts about thirty inches square, sixty feet apart and in the center of the street, and the practical elimination of the darkening of streets by the carrying structure except at stations, are worthy of special consideration among the many advantages offered.

A most important consideration in connection with this elevated railway is the cost of construction, which is approximately $150,000 per mile less than the cost of the ordinary double-track elevated railways, as we know them to-day. Where these ordinary systems are provided with solid concrete floors, the disadvantages in respect to cost when compared with the Strauss railway are still greater.

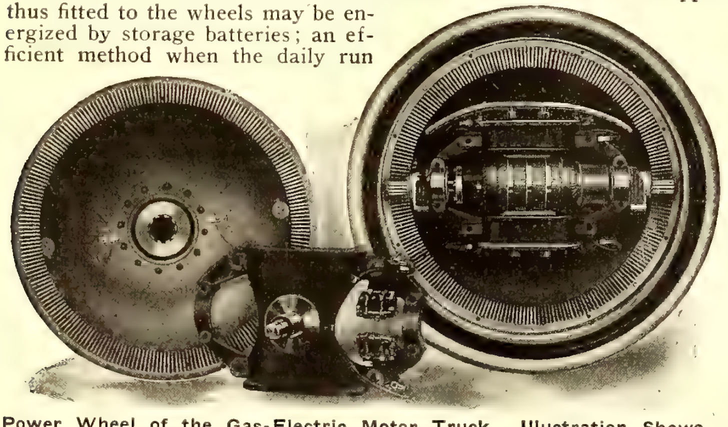
The economy of such a railway, in construction is due principally to the following:—the suspension of the cars, which permits a lighter car construction and consequently reduces the dead weight thruout; the projection of the car into the space between the girders which results in min-

(*Continued on page 931*)

NEW IN-BUILT ELECTRIC MOTOR WHEELS FOR AUTOS.

The average, and in fact most all gasoline auto trucks, drive thru their two rear wheels. However it has been found that when the total weight is evenly distributed over all of the drivers that a maximum tractive effort is attained. An example of this principle is seen in the design of modern locomotives. One of the four-wheel drive and steer designs which has been adapted to use on trucks for loads from three to ten tons makes use of four electric motors, which are ingeniously slung in the wheels themselves. The accompanying illustration shows the method of locating the motor between the two concave disks which serve as spokes and motor guard at once. On the opposite ends of the motor are two gears, alike and equidistant from the center or pivoting point of the motor. One of these pinions meshes in one of the big gears carried at the perifery of the large disks, and the other, on the opposite side, with the other gear on the second disk. It is thus evident that, as the motor revolves, one pinion *pushes down* on one gear as the other *pulls up* on the second gear, thus equalizing the strain and distributing the pulling effort evenly. The wires carrying current to the motor are brought in thru the axle and thus are thoroly protected. Hand holes are provided in the disks to permit access to the motors but they are so designed that they will run under very difficult conditions without overheating or developing other motor troubles. Each motor has a rating of three horsepower with an overload capability of 200 per cent, giving the truck a possible horsepower of 36 in an emergency—and of this amount 97 per cent, or approximately 35 horsepower, is delivered to the wheels at a point where it will do the most good—at the rim.

With the motive power thus direct geared to the wheel, with a 25 to 1 gear ratio, there is no transmission to contend with, and the problem of steering with all four wheels is simply a matter of linking steering arms so that all four wheels are controlled by the steering wheel, as all four wheels are mounted on swivels with the power wires leading in thru the spindles. The four-wheel steer gives a much shorter turning radius than it is possible to obtain with a front-wheel steer, and thus gives the truck greater mobility on crowded or narrow streets. The electric motors thus fitted to the wheels may be energized by storage batteries; an efficient method when the daily run does not exceed 40 or 50 miles.



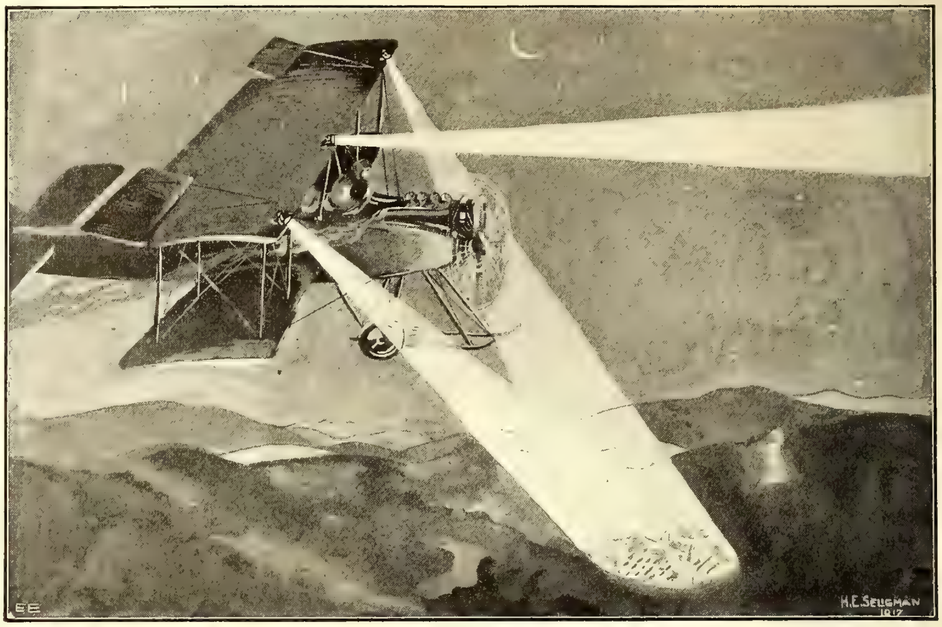
Power Wheel of the Gas-Electric Motor Truck. Illustration Shows Front Disk and Side of Motor Removed Giving Ready Access to All of the Moving Parts.

In some cases a gasoline engine is direct connected to a suitable dynamo (allowing the engine to run at constant speed) from which the current necessary for the four motor wheels is supplied thru a drum type controller. It has been found practicable to install two of these motor wheels on the front axle of an ordinary truck or wagon, supplying current from a storage battery. The rear wheels are the regular truck or wagon wheels. The superior flexibility of such a drive system is apparent.

What is reported to be the largest Pelton water wheel constructed in England has been built by James Gordon & Company, British manufacturers, for the Kinlochleven station of the British Aluminum Company. It develops 3,500 H.P.

Night Flying Now Made Possible

To reduce the dangers of night flying the Sperry Gyroscope Company has perfected a lighting outfit, to be carried in addition to the full equipment of automatic control devices, safety appliances and other instruments to insure the pilot a sufficient amount of safety. Three 50 candlepower searchlights are attached to a special fitting on the upper entering edge of the biplane which Mr. Lawrence Sperry has been using in night flying experiments at Amityville, L.I., for the past few months.



Lawrence Sperry, the Well-Known Inventor of the Automatic Aeroplane Stabilizer, Has Recently Accomplisht Some Excellent Night Flying by the Aid of Three Powerful Electric Searchlights. These Proved Invaluable in Selecting a Landing Spot.

The searchlights are mounted in parabolic reflectors which, it is claimed, increase the candlepower to 40,000 for each lamp. The fitting which secures the lamps to the upper plane is designed so that it can be tilted in the vertical plane by turning a knob, which is placed within easy reach of the pilot's hands. This device may be used as a means of signaling, and the lights can be made to focus on any given point, when the pilot is ready to make his landing.

The electric current is supplied by a generator of 150 watts capacity, which is driven by the air pressure at approximately 4,000 revolutions per minute. A storage battery is provided which is automatically thrown into circuit, in case of an accident to the generator.

The machine Mr. Sperry has been using is also equipt with the Sperry automatic pilot and synchronized drift indicator. This drift set was of great advantage to Mr. Victor Carlstrom in his flight from Chicago to New York.—*William Shannon.*

A.I.E.E. HOLDS MIDWINTER CONVENTION.

The midwinter convention of the American Institute of Electrical Engineers, lasting three days, was held in the Engineering Societies Building, 33 West Thirty-ninth Street, New York City, on Wednesday, Thursday and Friday, February 14, 15 and 16, 1917.

The convention opened Wednesday morning at ten-thirty and technical sessions were held each day. Wednesday's papers dealt with protective devices and the heating and temperature of generators. On Thursday three papers on electrophysics were presented at the morning session, and a lecture was given in the evening by Professor R. A. Millikan on "Modern Physics." Friday's sessions were devoted to the subject of a-c. and d-c. motor control. Thursday afternoon was set aside for a number of inspection trips to points of engineering interest in New York and vicinity.

The convention closed with a subscription dinner-dance at the Hotel Astor, New York, on February sixteenth. A large gathering attended the dinner-dance, which was greatly enjoyed by all.

DATE OF ISSUE.—*As many of our readers have recently become unduly agitated as to when they could obtain* The Electrical Experimenter, *we wish to state that the newsstands have the journal on sale between the fifteenth and the eighteenth of the month in the eastern part of the United States and about the twentieth of the month west of the Mississippi River. Our subscribers should be in possession of their copies at these dates. Kindly bear in mind however, that publications are not handled with the same dispatch by the Post Office as a letter. For this reason delays are frequent, therefore kindly be patient and do not send us complaints as to non-arrival of your copy before the twenty-fifth of the month.*

AN ELECTRIC MOTOR BOAT IN FIVE MINUTES.

The electric motor boat has always met with high favor on account of its noiseless working and cleanliness. In view of the success that the outboard motor has met, it is not surprising that an electric outboard motor has recently been placed on the market.

This outfit, which is illustrated herewith, is manufactured by a Chicago concern. The machine is of particular use in cases where simplicity of operation is desired, while for duck hunting or trolling a boat fitted with one of these little motors would prove ideal. As regards general layout, the machine closely resembles the conventional type of gasoline-driven outboard motor, being clamped to the boat in the usual manner.

The motor is placed directly above the main driving shaft which is contained in a telescopic tube, allowing the propeller to be adjusted to the correct distance beneath the surface of the water. The propeller is driven thru a modified type of worm gearing, which gives great speed reduction between the motor and the propeller, this being necessary, owing to the fact that the normal speed of the motor is about 3,000 revolutions per minute. Above the motor is a small steering wheel, which enables the propeller to be turned to the right or left hand, or completely around, if it is desired to reverse the direction of the boat. To this wheel may be fitted either a tiller or steering yoke, according to requirements. The outfit is made of aluminum and manganese alloy wherever possible, the idea being to reduce the weight to a minimum. The motor complete, but without battery, weighs only 50 pounds.

The armature of the motor runs on ball bearings, and the commutator and brushes are of special design, suitable for low voltages, as the motor is used with a storage battery of 6 to 12 volts. By means of a simple device the motor may be detached from the driving shaft and used for other purposes where power is required, the current being derived from the batteries in the boat. The standard storage batteries supplied with the regular equipment are two batteries of six volts, 120 ampere-hours each, but the manufacturers can supply a range of accumulators of 6 to 12 volts, having a varying capacity of 60 to 120 ampere-hours.

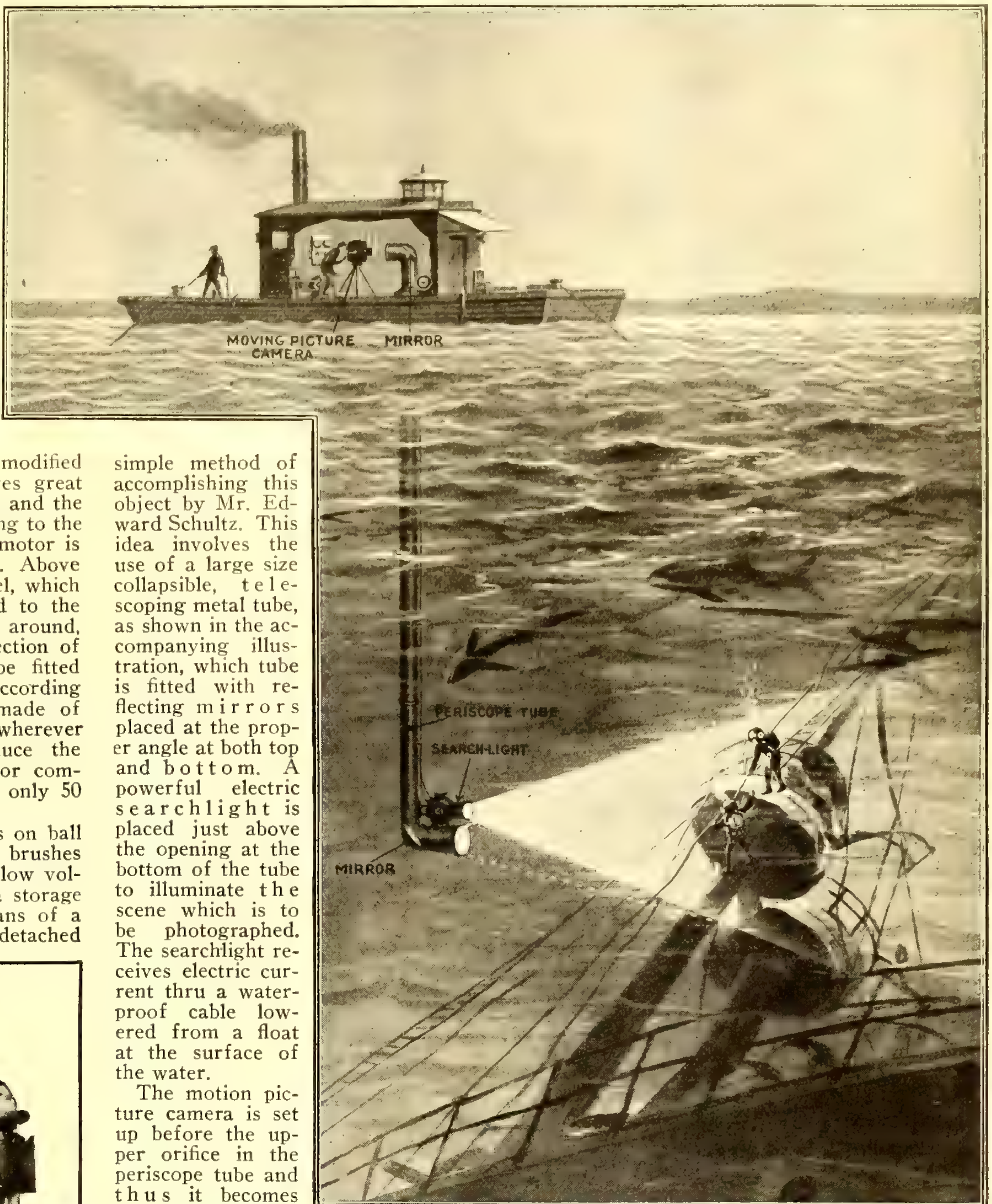
Here We Have the Electric Motor-Propeller Which Makes Any Boat a Motor-boat in Five Minutes. It Runs on a Small Storage Battery and a Child Can Operate It.

A NEW IDEA FOR TAKING SUBMARINE "MOVIES."

While there are a number of schemes in existence for taking submarine motion pictures, we have recently had submitted a unique and simple method of accomplishing this object by Mr. Edward Schultz. This idea involves the use of a large size collapsible, telescoping metal tube, as shown in the accompanying illustration, which tube is fitted with reflecting mirrors placed at the proper angle at both top and bottom. A powerful electric searchlight is placed just above the opening at the bottom of the tube to illuminate the scene which is to be photographed. The searchlight receives electric current thru a waterproof cable lowered from a float at the surface of the water.

The motion picture camera is set up before the upper orifice in the periscope tube and thus it becomes possible, according to Mr. Schultz's invention, to readily photograph the subaqueous flora and fauna, as well as any other moving objects such as divers, fishes, etc.

Electrical energy for operating the searchlight is obtained from a small dynamo driven by a steam or other engine mounted on board the vessel at the surface of the water. While this scheme apparently loses a great deal in efficiency owing to the projection and reflection of the scene from one mirror to another, from the optical point of view, still there is considerable merit in the fact that the camera does not have to be submerged in any way. Also, with this arrangement, it is possible to quickly change the view by raising or lowering the periscope, which is also revoluble about its axis, all of which tube movements are cared for by a small quick-acting electric motor and appropriate control apparatus on board the float. The searchlight may also be turned on and off and its power regulated from the float.



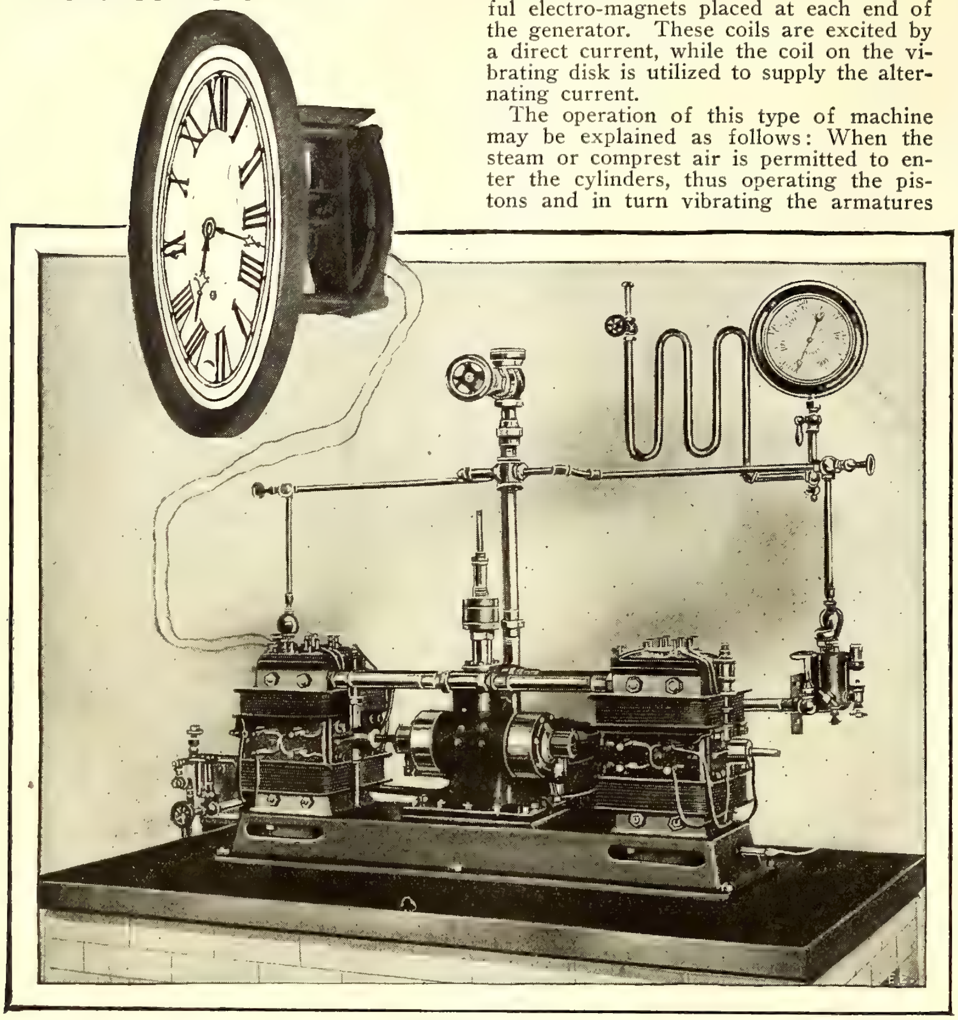
Submarine Motion Pictures Are Very Valuable, Both for Theatrical and Educational Purposes. With the Scheme Illustrated It Becomes an Easy Matter to Take Such Pictures, a Powerful Electric Searchlight Illuminating the Scene, While the Camera Films the Image Projected up the Telescopic Tube.

CANADA'S WATER POWER.

Canada's available water-power, allowing for limitations imposed by international agreements in connection with Niagara Falls, and one or two other sources, amounts to 17,746,000 h.p. Excluding the Northwest Territories and the Yukon, about 1,712,000 h.p. out of this total is already being utilized. If the present rate of progress continues, it is calculated that something like 8,000,000 h.p. will be made available during the next fifteen years.

A Novel Tesla Steam-Electric Clock

Among the various wonderful inventions of Dr. Nikola Tesla we find one of the most interesting clocks ever made, and the accompanying photographs show the necessary equipment for this highly ingenious and novel electric clock.



A Steam-Electric Clock Devised Some Years Ago by Dr. Nikola Tesla, the Electrical Wizard. It Comprises an Air or Steam Engine Which Operates Two Special Oscillating Alternators. These Are Wired Up to a Special Motor on the Clock—the Entire Combination Keeping Extremely Accurate Time, It Is Said.

The clock proper, shown above, is apparently no different from any other standard clock. However, the mechanical movement has been removed and substituted by another special movement linked up with an alternating current motor of special construction which can be seen at the extreme right of the clock. The field consists of a number of rectangular coils placed in torroidal form and connected in series. The rotor or armature is constructed of a circular iron disc, the periphery of which consists of a large number of poles. The speed of this rotor is controlled by the current input. Connections between the rotor shaft and that of the clock hands is obtained by means of a number of reduction gears properly calculated so as to obtain the correct time, when the hands are acted upon by the motor.

The source of current for driving this remarkable electric clock motor is obtained from an alternating current generator of very unique construction and design, this machine being illustrated here. It consists of two steam or compress air cylinders, built in one frame as shown. A piston is placed in each of the cylinders which operate alternately with respect to each other. The connecting rods of each piston are linked with a vibrating membrane of each dynamo; these are seen at each end. A coil is placed on each membrane and connected to a special commutator. The electro-magnet or coil is operated in a powerful magnetic field, made up of two powerful electro-magnets placed at each end of the generator. These coils are excited by a direct current, while the coil on the vibrating disk is utilized to supply the alternating current.

The operation of this type of machine may be explained as follows: When the steam or compress air is permitted to enter the cylinders, thus operating the pistons and in turn vibrating the armatures or coils, an electro-motive force is induced in the coil by virtue of being moved in the magnetic field surrounding it. The period or frequency of vibration of this current depends upon the rapidity of the armature movement. Both generators are linked in such a manner that an alternating current of uniform form and periodicity is obtained.

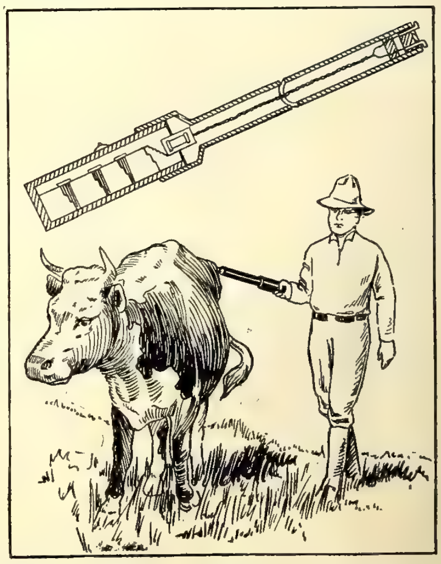
The motor on the clock is connected with this special generator and the current is so adjusted that a uniform velocity of the rotor is always obtained in order to obtain absolutely correct time from the clock.

A large number of such clocks were installed in the laboratory of Dr. Nikola Tesla a number of years ago which are driven by a single generating unit. It is said that the accuracy of time attained by this ingenious clock system is far better than with any other system known.

AN ELECTRIC "PROD" FOR ANIMALS.

The *electric prod* is the successor of the big bull-whip which at one time was so generally made use of by men who had horses and cattle in their charge. The general activity of the societies for the prevention of cruelty to animals with its organization all over the country, has been the means of putting the ugly old bull-whip out of business, for at the present time, it is a rare thing to see them even in the establishments devoted to the sale of harness and such things.

The electric animal prod has just been patented by a resident of Fort Worth, Texas, which has recently developed into a large cattle center, and the prime object of the prod is to hasten the movements of the cattle being past thru the abattoirs of that place. The prod is an elongated body with several batteries and an electric coil concealed in the handle. At the other end of the device are two contact points, spaced a small distance from each other. When this end of the apparatus is applied to the body of the animal, the circuit is established between the two points and the animal experiences an electric shock.



When "Bossie" Becomes Unruly It's an Easy Matter to Hustle Her Along with This New "Electric Shocking Prod."

PROF. CLERK MAXWELL A POET THIRTY-SEVEN YEARS AGO.

The late Prof. Clerk Maxwell was in the habit of recreating his mind from its severer tasks by penning amusing physiocomic parodies of well-known poems. One of the best of these was his electric valentine, which runs as follows:—

ELECTRIC VALENTINE.

Telegraph Clerk A to Telegraph Clerk B.

"The tendrils of my soul are twined
  With thine, though many a mile apart;
And thine in close-coiled circuits wind
  Around the magnet of my heart.

"Constant as Daniell, strong as Grove;
  Seething thru all its depths, like Smee;
My heart pours forth its tide of love,
  And all its circuits close in thee.

"O tell me, when along the line
  From my full heart the message flows,
What currents are induced in thine?
  One click from thee will end my woes."

'Thru many an Ohm the Weber flew
  And clicked this answer back to me—
"I am thy farad, staunch and true,
  Charged to a Volt with love for thee."

$\frac{dp}{dt}$

The inscrutable signature $\frac{dp}{dt}$ is adopted from the fundamental equation of thermodynamics $\frac{dp}{dt}$ =J.C.M. (James Clerk Maxwell). This explanation reminds us that the famous colleague physicists, Thomson and Tait, are familiarly known to their students as T. and T., nicknames also drawn from the jargon of thermodynamics.—*Electrician, London.*

ENERGY NECESSARY TO OPERATE A TROLLEY CAR.

It requires on the average about 125 watt-hours per ton-mile to operate a car in city service. Translated into a more comprehensible unit, this is 166 foot-tons. That is, the same amount of energy is required to move the car one mile on the level as would raise it vertically 166 feet. All of this energy goes into heat, part of the loss being preventable, the balance otherwise.

TUNGSTEN LAMPS FOR KANSAS CITY STREETS.

Kansas City is the first large city to replace all of its street arc lights with nitrogen filled tungsten bulbs. Fourteen hundred of the new bulbs, which are now being installed, will save the city, it is figured, more than $30,000 each year. This saving will be invested in providing better lighting facilities for the newer sections of the city.

A NEW AND PRACTICAL TROLLEY BOAT.

By Raymond F. Yates.

The *trolley boat* shown in the illustration is not an experiment, but a practical arrangement actually in use at one of the big power company's plants at Niagara Falls. Ice, flowing down the river from the Great Lakes, has always been a menace to the operations of the power companies at Niagara, and this powerful, electrically propelled vessel is used to prevent ice from jamming in the intake canals, where it causes serious trouble by preventing the proper amount of water from flowing into the penstocks. By means of a perfect control system, this little craft is surprisingly active and darts to and fro with remarkable rapidity, striking the huge cakes of ice and sending them on their way.

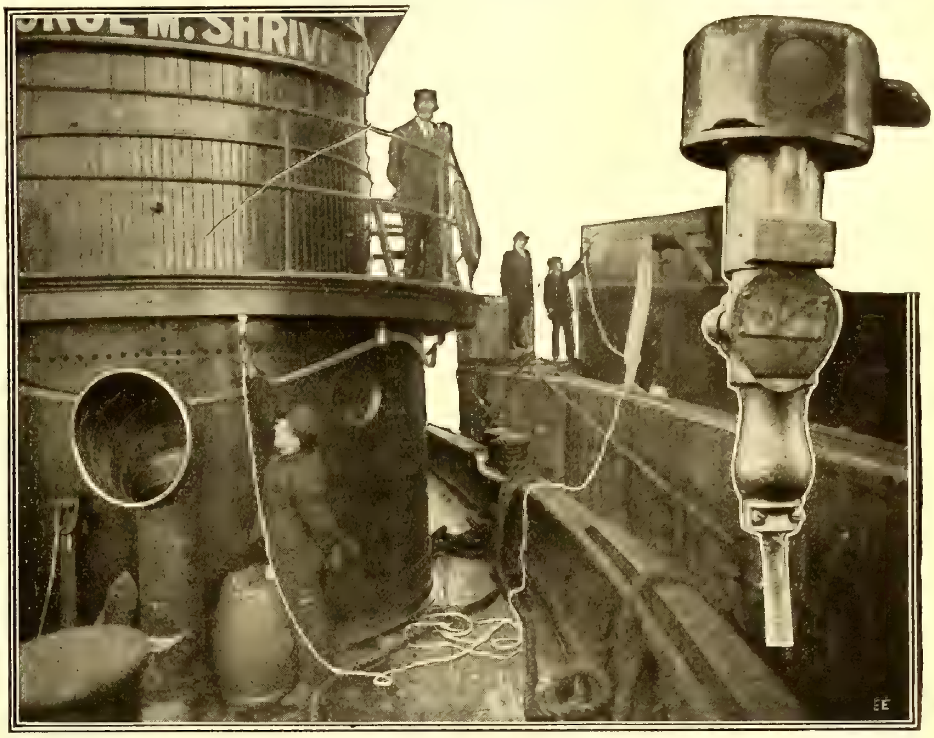
The hull of the boat is made of steel, and its power equipment consists of one 75 H.P., single phase, 220 volt, 25 cycle railway motor. The motor is connected to the propeller shaft thru a single train of reducing gears, with a ratio of 16 to 66, which causes the propeller to revolve at 240 R.P.M. at full speed. The maximum speed of the motor is 1,000 R.P.M., and intermediate speeds are obtained by means of a regular drum controller and grid resistances. The power leads are brought in at the top of the small pole as shown in the illustration. The top of the pole is equipt

One of the Large Power Companies at Niagara Falls Have In Service Several of These Unique Electric "Trolley" Boats.

with a commutator and swivel arrangement permitting the vessel to travel in any direction and still receive its necessary power for locomotion.

Tug Dispatching Via Telephone

The movement of the tugs handling the barges and car floats at the Baltimore and Ohio terminus in New York is controlled at a central point by a dispatcher, who instructs the captain by telephone where to connected by tie lines, and the tug dispatcher is thus reached. In Brooklyn the jack at the end of the pier is bridged to an individual line. In this case the dispatcher is reached by means of toll lines



The Telephone Is Proving More Indispensable Every Day—Here We See It Adapted to the Requirements of Tug Dispatching At One of the Large Eastern Railroad Terminals. Connecting Jack On Pier Shown Enlarged At Right.

call and the point of delivery, thus saving considerable time.

In order that the captain may more readily communicate with the tug dispatcher, the New York Telephone Company has recently installed for the B. & O. Railroad Company a complete telephone tug dispatching system, whereby the captain of a tug without leaving his boat may communicate directly by telephone with the dispatcher, who is located at St. George, S.I., at any time of the day or night when the tug is at dock. This installation was made by means of regular jack and plug steamer equipment. Common battery telephone sets of the hotel type were installed in the pilot house of each of the ten tugs of this terminal and on two steam lighters.

The instruments are placed permanently and are wired to two permanent jacks on the exterior of the boat, one on the bow and one on the stern. Other jacks are located on the sea end of ten of the Baltimore and Ohio piers at different points in Manhattan, Brooklyn and St. George, S.I., the latter point being the New York freight terminal of this railroad company. The jacks on the piers in New York and St. George are bridged to extension lines connected to the railroad's different private branch exchanges at each place, which boards are to the St. George's exchange switchboard.

Connections are established by means of a flexible deck cable with a plug on each end, which is carried on each boat. When a boat lands at the dock a member of the crew plugs one end of the flexible cable into one of the jacks on the boat and then goes ashore and inserts the other end into the jack on the dock; the service is then ready for the captain to make a call from the pilot house, the same as from any other extension station. Photo courtesy *The Telephone Review.*

BENEFACTORS!

I doff my hat
To my friend Brewster,
Whose auto killed
My neighbor's rooster.
—*Cincinnati Enquirer.*

We tip our tile
To Colonel Huppy,
Whose flivver slew
Our neighbor's puppy.
—*Macon Telegraph.*

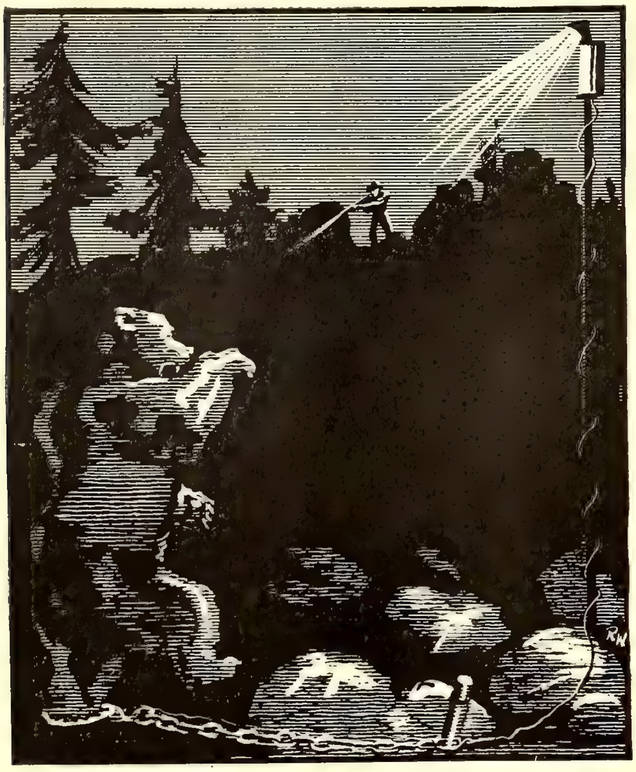
Our chapeau's off
To Ezra Pratt,
Whose twin-six smasht
Our neighbor's cat.
—*Columbia State.*

My lid is doft
To Hiram Prote,
Whose honk-honk got
My neighbor's goat.
—*Yonkers Statesman.*

My stovepipe's off
To Henry Lord,
Whose racer squasht
Our neighbor's "Ford."

ELECTRIC LIGHT FLASHES WHEN ANIMALS ARE TRAPT.

A Western trapper has arranged an electric system which lights a small electric bulb when a trap is sprung, enabling him to locate it in the darkness and shoot the animal. The method of arranging the



When Mr. Bear Lands in This Electric Trap a Light Flashes Up, Enabling the Trapper to Readily Shoot the Animal.

electric light attachment is shown in the accompanying illustration. In most cases a battery proves the easiest solution of the current supply problem. A simple switch arrangement connected to the trap serves to close the lamp circuit when the trap is sprung.

THE STRIKING BAG AS A STATIC GENERATOR.

By Bernadotte Anderson.

The other evening I discovered a curious phenomenon when proceeding to work out my usual bouts on the striking bag (or should "punching bag" suit your fancy, we will call it that).

Preferring to get as much outside air as possible, I set up the apparatus for the bag in a shed in the rear of the yard, instead of in the garret or cellar, and where the noise from the bag would not be objectionable.

Having previously noticed how much the air in the bag would contract, due to the extreme cold weather, I decided to detach and hang it in the house, where it would expand considerably under the warm temperature.

It happened to be a cold, crisp and clear evening the next time I made ready to do some more punching stunts and starting to beat up severely on this defenseless exponent of gymnastics, it rebounding with extreme agility under the influence of the heated and expanded air within itself, the curious phenomena of *static electricity* exhibited itself in a marked degree at every stroke of the bag. The room being dark, it was quite an interesting sight to notice the imprint of the hands which manifested itself in electrical impressions at the point of contact. Those who are interested in physics and happen to have a punching bag and can put it thru the role that I did, under the required conditions, should experience similar results.

I assume that the law of physics which made this experiment possible was that the heated air inside the bag was one side of a static condenser; the rubber and leather covering, the dielectric medium, and the hands the other side. Thence, when causing the bag to oscillate rapidly, which corresponded to the frequency of the charging medium, produced the described effects. As the discharge did not take place until after making a few preliminary rapid violent strikes, I also assume the deduction that this was the period when the *condenser* was receiving its initial charge and that every blow of the hand after the point of full capacity charge acted as an overflow discharge between the hands and the bag.

This is one of the numerous incidences where nature's wonderful medium we call *static electricity* exhibits itself in such illusive and fascinating forms, and causes one to pause with the inevitable desire to grasp its possibilities were it possible to harness these ethereal vibrations and store their energy for future service, as readily as man's genius has made it feasible to record the human voice and reproduce at will and to store electrical energy in storage batteries.

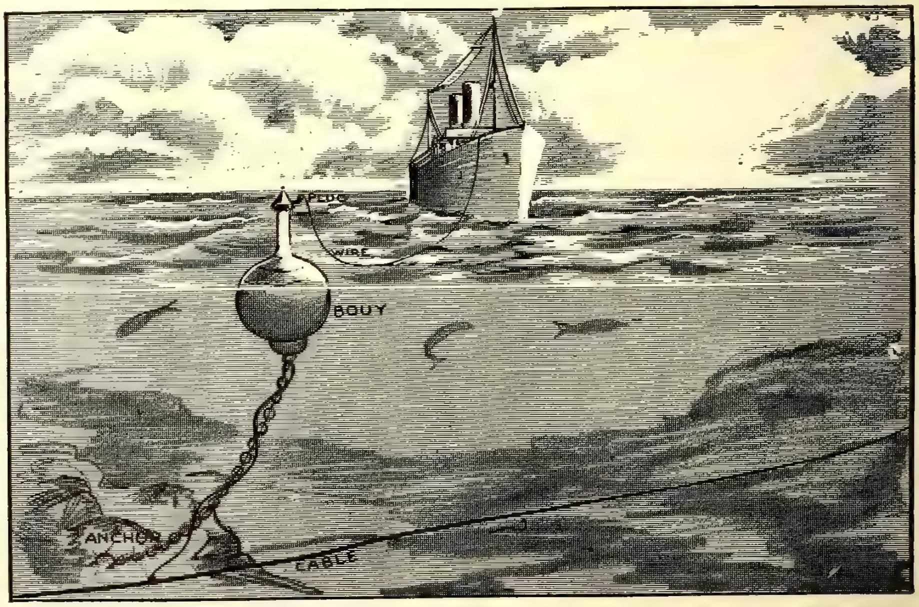
WHY NOT CABLE BUOYS IN MID-OCEAN SO SHIPS COULD TALK TO SHORE?

While we have wireless telegraphy and telephony available for ship to ship and ship to shore communication, it is hardly probable that we shall want to build or lay submarine cables arranged with tap-off junctions every fifty miles or so, connected with buoys floating on the surface of the ocean so that ships might plug in on one of these buoys and communicate with shore. However, it is an interesting thought nevertheless and the scheme has been promulgated by a youthful electrical genius of Buffalo, N.Y., one Edward Schultz.

Mr. Schultz proposes that submarine cables be provided at short distances with a junction box and at these points buoys would be permanently anchored by means of a chain or wire cable in the manner illustrated. A connecting wire runs from the junction box on cable to the buoy.

When the ship wishes to communicate with shore it approaches one of these buoys and lowering a small boat the ship's electrician proceeds to the buoy and establishes the communication between it and the vessel by means of a flexible insulated electric cable, one end of which is secured to the ship, of course, and the other end of which is carried by the small boat to the buoy. When the message has been telegraphed, the reverse procedure occurs, i.e., the ship's electrician goes to the buoy in a small boat and disconnects the cable; after he has returned to the large ship the cable is reeled up on deck and the vessel proceeds on its way.

These buoys could be suitably illuminated at night, so that connection with them could be readily established. The inventor, who is only nineteen years of age, has several other clever ideas in mind for the application of this scheme. He mentions that in time of war the buoys could be suspended or anchored so as to be a short distance beneath the surface of the water and that these locations be marked on the charts carried by the ships of the nation to whom the cable belongs. It would thus be an easy matter to establish connection with the buoy, even tho a diver had to be employed for the purpose. The inventor also advances the idea that it might be possible in this way to transmit electrical energy to vessels for the periodical recharging of storage batteries, presumably for those cases where a ship may have become dis-



Why Not Have Cable Buoys Located Along Steamship Routes Across the Ocean? Says Mr. Edward Schultz, a Youthful Inventor, So That Ships Could Communicate With Shore. Not a Bad Idea.

abled or for certain other purposes. Electric current, according to the inventor, could also be sent along the cable to light the buoy lamps, ad lib.

HOW TO READ YOUR OWN ELECTRIC METER.

By Walter F. Current

A GREAT many persons who have their homes lighted by electricity, know practically nothing about reading their meter. There are a multitude of people who will not pay their grocery account before they look over the bills for mistakes, but they will blindly pay their electric light bill without knowing whether it is correct or not. Your meter reader is human and is just as liable to make a mistake as your grocer. Therefore, everyone should know how to read his own meter, and how to keep a check on his electricity bill. If you do find an error in the bill, you will find that the electric light company will be more than glad to rectify the mistake.

The purpose of this article is to help those who do not know how to read their meters, and to help them to keep a check on their electricity bills. In the first place, perhaps, you would like to know what a *kilowatt-hour* is. The word is made up of three words, namely, kilo, watt, and hour. *Kilo* is a Greek word meaning one thousand, and it is often used in the English language to express one thousand. Thus a kilometer is, in the metric system, one thousand meters. The *watt* is a unit of electric power, and is one thousandth of a kilowatt. The *hour* used is the common hour of sixty minutes. Thus it is easily seen that a kilowatt-hour is simply one thousand watt-hours. Practically a kilowatt-hour is one thousand watts used for one hour, or one watt used for one thousand hours.

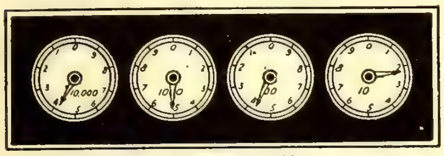


Fig.1 Reading 4542

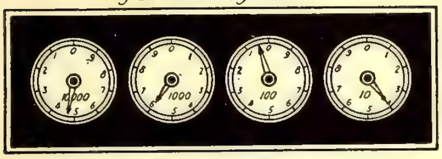


Fig.2 Reading 4604

The meter records the kilowatt-hours on a dial, by means of a clock-work mechanism. This dial consists of three or more circles of figures placed side by side, or in the shape of an arc. Each circle has a pointer which is operated by the rotating element in the meter and which points to the figures on the dial.

Meters are all read alike so we will take one with a dial of four circles for an example. *You begin at the right hand circle* to read the meter, *and continue to the left* until all of the circles have been read. Suppose, for instance, that the pointer in the first circle (right hand) points to 4, the second one to 8, the third to 5, and the fourth to 1. Then, if you have set your figures down in the same order in which you have read them the meter reading will be 1,584 kilowatt-hours. The right hand figure in your result should be the same as the figure which the pointer indicates in the right hand circle, which in this case is 4.

The first circle in the dial usually has the figures reading in a *clock-wise* position, the second in a *counter-clock-wise* position, the third clock-wise, and the fourth counter-clock-wise, as is shown in the accompanying illustrations. In the first example the pointers were all pointing to some definite figure, but suppose that in the second circle, the pointer was between 4 and 5; how can we tell whether to call it 4 or 5? In this case the number which the pointer is leaving is the one to use. Therefore the reading for Fig. 1, is 4,542 kilowatt-hours. For in the first circle to the right the pointer is just leaving 2, and it must be read as 2. In the second, the pointer is just leaving 4, and must be read as 4. In the third, the pointer is just leaving 5 and it must be read as 5. The last circle reads 4.

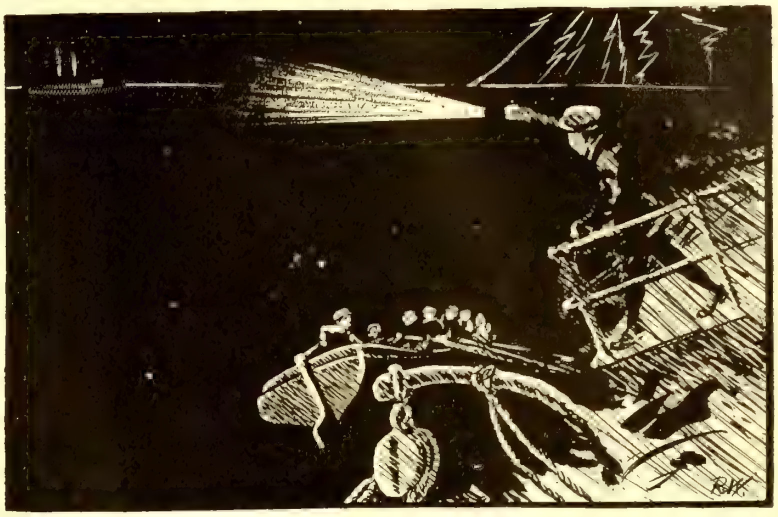
Let us take another illustration. In Fig. 2 the first pointer reads 4, the second 0, the third seems to be pointing directly at 6, but the question is—has it reached 6, is it between 5 and 6, or is it between 6 and 7? If it has past 6 it will be called 6, but if it has not passed 6 it must be called 5. This must be determined by the pointer next to the right. This is half way between 0 and 1, therefore it must be just starting on its trip around the circle, and this being the case, the pointer in question must be just starting to go from 6 to 7. It is just leaving 6. The fourth pointer reads 4, therefore the reading is 4,604 kilowatt-hours.

Let us suppose that the reading in Fig. 1 was your meter reading for one month, and the reading in Figure 2 the reading for the next month. By subtracting the first from the second, we get 62 kilowatt-hours as the meter consumption for this month. Then supposing that the electric light company charged $.09½ per kilowatt-hour, the bill for the month would be .09½x62=$5.89. Always note if your meter dial board has any remarks on it giving a factor by which to multiply the dial reading. If it should state—multiply by 4—then you simply have to multiply the reading as found above by 4 to ascertain the net result.

Thus it is seen how easy it is to check up your electricity bill, and I hope a great many of the persons who read this article will be benefited by it.

POCKET SEARCHLIGHT SAVED ELEVEN PEOPLE.

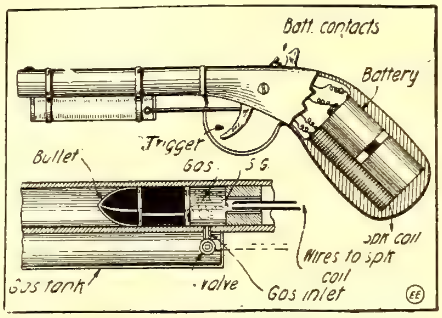
The presence of a young lad with an electric searchlight and a knowledge of the wireless signal code on the steamship *Pio IX* recently led to the rescue of eleven of that ship's company by the steamship *Buenos Ayres*. The captain of the latter vessel saw small, glimmering lights and the signals flashed out by the amateur were translated by the ship's wireless operator. The rescue followed, but not until a large number of members of the crew had been lost in the storm. It was a curious use of the common little electric novelty, but it suggests a method of supplementing wireless service over short distances. With powerful searchlights supplementing the wireless code, the process of near-by signaling would be much simplified.



The Pocket Electric Flash-Light Is Not Only of Invaluable Service In the Home, But In One Instance Served As the Means Whereby Telegraph Code Signals of Distress Were Flashed by a Boy On a Sinking Liner, Saving Many Lives.

THE ELECTRIC PISTOL COMMANDS—HANDS UP!

An inventor has turned out an electric pistol, built along original lines. It does not use gunpowder or cartridges, but is so constructed that its contents, gases, are exploded by a touch of the button and a projectile is expelled. The pistol consists of a brass clinder, at one end of which is a small battery and coil. The gases are introduced from the outside or from a small tank attached to the pistol frame. Altho the use of electricity in this case is merely an experiment, it is evident that it can be used to produce exactly what powder does, explosion in a confined space and the swift movement of a missile. Mankind began with a club and a stone to deliver blows. The bullet is only a smaller but speedier object than a hand-thrown stone, wounding at a greater distance than is possible with a spear or arrow.



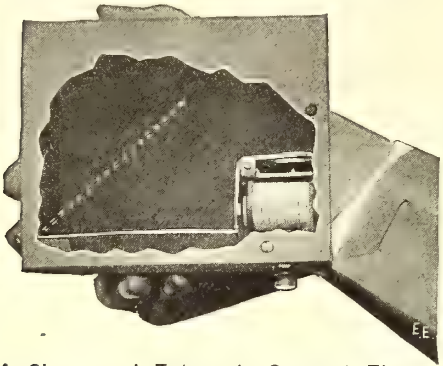
The Electric Pistol Is the Latest—An Electric Spark Ignites a Charge of Gas, the Explosion Forcing the Bullet Out of the Barrel.

RADIO MESSAGE SENT 112 MILES FROM AEROPLANE.

Emil J. Simon, a radio engineer of New York City, temporarily attached to the Army aviation school at San Diego, Calif., with Captain Herbert A. Dargue as pilot, sent a radio message from an aeroplane over a distance of 112 miles to the receiving station at the school.

CONTROLLING THE FURNACE DRAFT ELECTRICALLY.

One will admit that it is very inconvenient for the housewife to be forced, especially in cold weather, to adjust the draft doors in order to improve operating conditions.

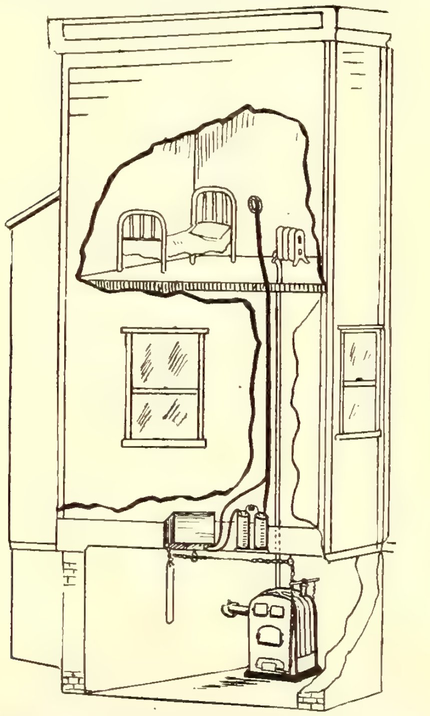


A Clever and Extremely Compact Electro-Magnetic Device which Automatically Opens the Furnace Drafts.

This inconvenience has been overcome by Mr. Walter Hann, who employs a very simple, yet ingenious electro-magnetic device for this purpose. This is shown in the photograph and consists of nothing more than a flat iron bar pivoted on one end of which is a hook to hold a weight. Normally this bar is kept in an horizontal position and held there by means of a pivoted armature, supported on an electro-magnet as shown. This magnet is connected to two dry batteries and a push button. The connections are made from the two binding posts at the bottom.

The iron weight attached to the arm carries a chain which is past thru a pulley and connected to the draft door of the stove or furnace. A schematic diagram of such an installation is given herewith, which shows clearly the manner in which the electrical draft control is attached and its main accessories.

Its operation is very simple and may be explained as follows: Suppose that more heat is necessary; this is compensated for by increasing the draft by pressing the push button stationed anywhere in the house; the electrical circuit of the battery is completed and the electro-magnet in turn attracts its armature, which releases the long arm. The weight, which is appended to the arm is caused to drop, which, in virtue of its mechanical connection with the draft door, opens it automatically and in this way permits more air to enter the fire box. This naturally increases the temperature of the furnace and consequently more heat is obtained.



Section of House Showing Automatic Electric Control of Furnace Draft Installed. A Push Button Beside the Bed Actuates It.

HOT WATER BY ELECTRICITY IN 8 SECONDS.

Mother certainly has cares enough without being constantly aggravated and inconvenienced by having no hot water when she wants it most. Be it the fault of the janitor or of the old-fashioned water-back on the range or gas stove, or perhaps the lack of any heater, the result is always the same—she must resort to the tedious process of heating a small quantity of water in a kettle. This takes time, and when the supply is used up, she must boil another kettleful and wait until it is hot. More time and temper lost! This is one of the unnecessary cares many women are forced to endure.

On the other hand, observe the instantaneous electric water heater here pictured, which measures twelve inches in length and is attacht to any cold water pipe. The heater consists of a resistance wire extending thru a series of holes or passages in a cylindrical body of porcelain contained in a metal casing.

Instantaneous Hot Water Is Available with This New Electric Water Heater which Can Be Attacht to Any Cold Water Pipe.

The water circulates thru the same passage that contains the resistance wire and is drawn off as needed by opening the faucet. The turning of the handle of the faucet by the user, automatically actuates a double-pole snap switch for turning the electric circuit *on* or *off*. The temperature of the water can be regulated by the quantity of flow from the faucet at any temperature up to 212° Fahrenheit.

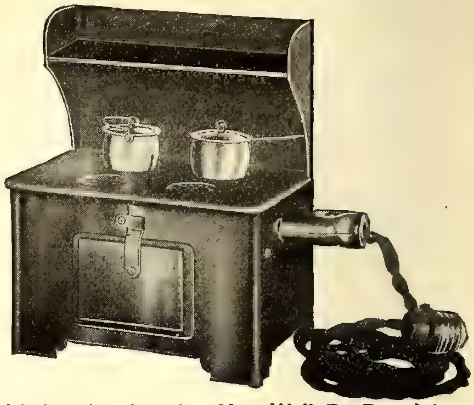
It is claimed that this machine has withstood the most severe tests, producing a continuous efficiency of 98%. Chemical analysis of water heated by this machine has shown a total absence of electrolysis. It is a great boon for shaving, medicinal uses, etc., particularly in the latter case, as most people have a fear of being poisoned by scale or other foreign matter, sediment, et cetera, which may accumulate in the ordinary boiler or water heater in which the water has a chance to corrode the metal. The present device heats fresh, cold water right from the supply pipe.

NEW ELECTRIC HAND MIRROR.

The electric hand mirror is the newest vanity wrinkle of the boudoir. The mirror contains a battery and a small electric bulb to throw the light on the face of the user.

ELECTRIC TOYS THAT REALLY WORK.

While the miniature instrument here shown is a *toy telephone*, and while the price is so low that it is in great demand as a toy for boys and girls, it is so well made and operates so satisfactorily that it is really well fitted for practical use. The receiver and transmitter are of the simplest possible construction and yet are thoroly efficient. This telephone is equipt with push button and calling device for signaling and the circuit requires only two wires for both ringing and talking. It can be used to communicate from one room to the other in a house, or from house to house over moderate distances or from house to barn or garage. The cabinet and all parts are nicely finished in a manner which will be acceptable in any home. This desk set is almost a replica of the regular standard desk telephone. It is said to be the only real toy desk stand on the market that operates electrically, just the same as any other telephone. In these toy telephones a very efficient little watch-case receiver and sensitive gold electrode transmitter are used, so that the transmission is perfect.



Little Miss America May Well Be Proud to Possess One of These Miniature Electric Ranges which Cook Just Like Mother's. They Operate from Any Lamp Socket.

The other electric toy novelty shown is an electric toy stove furnished complete with cord, plug, detachable connector, and with two cooking utensils. It weighs 2 pounds, 7 ounces, and is a practical cooking device. It provides hours of fun and pleasure to the juvenile mothers of the land who are so fortunate as to possess one and the price is within reach of most everyone.

The trend of all modern toys is toward practicability. Will it prove instructive as well as entertaining is the all-important question. The miniature electric range here shown will please every little girl that owns one, for with it she can actually cook and no matches enter the game.

A Toy Telephone that Works to Perfection.

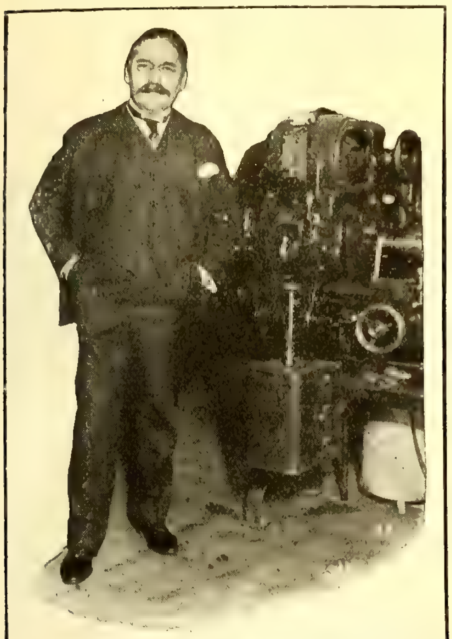
CORRECTION.

I beg to call your attention to a slight mistake in the January issue, regarding the installation of Radio stations by the Montana Power Company.

The station referred to as Spring Creek is located near Lewistown, Montana, and was installed as a private station by Mr. A. C. Campbell. The other station referred to as the Rainbow Hotel station is located at the Rainbow Power Plant, near Great Falls, Montana, and was installed by myself.—C. H. WATSON, R.E.

PROF. PUPIN MAKES VALUABLE RADIO INVENTION.

Prof. Michael I. Pupin of Columbia University has just devised and announced his perfection of a method for eliminating static interference with wireless transmission. This interference has been the great drawback to wireless telegraphy since that means of communication was invented.



Prof. Michael I. Pupin, Columbia University Savant, Who Announces a Startling Discovery in the Elimination of Radio Interference.

The new invention, if it accomplishes perfectly its object, will be listed as one of the most important electro-physical discoveries ever made. Under present conditions it is often impossible to get wireless messages thru for days because of atmospheric and other physical interferences, and at all times of the year during portions of the day transmission is impossible. Prof. Pupin's invention, however, is intended to make it possible to use the wireless for twenty-four hours a day every day in the year. The importance of the invention in time of war is incalculable.

The inventor has announced that he has placed at the disposal of the War Department his new method of eliminating static interference with the transmission of messages by wireless telegraphy. One of his most famous inventions is the *Pupin loading coil system*, for telephone lines, which has made possible greatly extended distances over which telephone communication can be held. In fact it practically doubled the ordinary range attainable without loading coils.

ELLIOTT CRESSON MEDAL AWARDED E. F. NORTHRUP FOR ELECTRIC FURNACE RESEARCH.

The Franklin Institute has recently awarded its Elliott Cresson gold medal to Edwin Fitch Northrup, research physicist, of Princeton, N.J.

This award was made in recognition of a special type of electric furnace developed by Dr. Northrup, in which a temperature of more than 3,000 degrees centigrade can be developed, and of his pyrometric methods and new pyrometric apparatus for the direct and accurate reading of high temperatures up to 1,600 or 1,700 degrees centigrade. Means are provided whereby, with a slight modification in the pyrometric apparatus, rapid measurements can be made of the resistivities of many molten metals and other liquid materials through a wide range of temperature.

DAY SET FOR FINAL HEARING OF TUCKERTON RADIO SUIT

Vice-Chancellor Stevens, at Trenton, N.J., has fixt September twelfth as the date for final hearing in the suit brought by the Compagnie Universelle de Telegraphie et de Telephonie sans fil to compel specific performance of a contract for the conveyance to it of the radio station at Tuckerton built by the Hoch-Frequenz Aktiengesellschaft fur Drahtlose Telegraphie. The French company had asked for the prompt disposition of the matter in issue on the pleadings as filed by the respective parties to the suit.

The German company had opposed a disposition of the case on the filed pleadings, urging that it should have the opportunity to take testimony in Germany relating to the amount expended on the two stations and other matters bearing upon the litigation. Vice-Chancellor Stevens took this view, but added that the taking of testimony should not be permitted to stay indefinitely the proceedings. Six months would be a reasonable time to give the company he says in the order fixing the date.

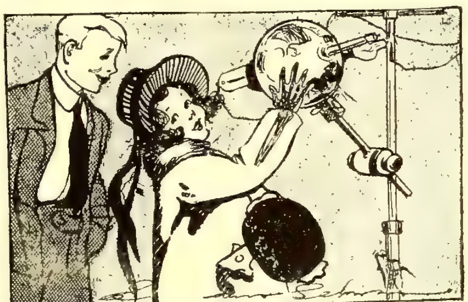
The court also held that the option taken by the French company is in such form that, even tho it may be impossible because of the war, to acquire possession of the corresponding station in Germany at this time, this would not prevent enforcement of so much of the contract as pertains to the Tuckerton station.

A NEW DISCOVERY.

The New York *Evening World* is admittedly a great paper. It does quite a good deal for education in general and is as instructive as it is entertaining. Just now it is running a special feature for children: "Dicky and Dot in the Wonder City," conducted by Eleanor Schorer. The series is a good one and instructive as well, and the kiddies sure do like it.

But might we suggest to Miss Schorer that she become a regular reader of THE ELECTRICAL EXPERIMENTER? It would help her to conduct the series technically correct, which we are sad to see, is not being done now. Several glaring mistakes have appeared so far and we reproduce the latest herewith, simply to show how bad a little knowledge sometimes is:

The illustration with caption taken from the *Evening World* of February twenty-second tells the story better than words. It gives children as well as grownups a totally wrong idea of the X-ray. For as our readers know well, X-rays are invisible to the human eye. In order to see the bones of the hand it is quite necessary to interpose a platinum-barium-cyanide screen, or other fluorescent screen, between the eye



How a New York Daily Paper Imagines the X-Ray to Work—Place Your Hand Against the X-Ray Bulb and Presto! You See the Bones. But—Well, Read the Above.

and the hand. Otherwise nothing is seen. The vitally necessary screen could have been shown by the artist without much trouble. As the illustration stands, it is decidedly misleading.

TELEPHONIST SAVES 1700 LIVES IN MUNITION FIRE.

One of the most courageous acts that it has been our duty to chronicle is that of Miss Tessie McNamara, who distinguished herself by sticking to her post at the gigantic munition fire which wrecked the plant of the Canadian Car and Foundry Company at Kingsland, N.J., on January 11, 1917. Shells screamed thru the air and burst all about the building in which the brave young lady kept at her duty—but let us listen to the words of Miss McNamara herself. Her interview follows:

Ladies and Gentlemen: Meet Miss Tessie McNamara, the Telephonist Heroine; Who Stuck to Her Post and Saved 1700 Lives in the Kingsland Munition Fire.

"About 3:45, while handling the usual volume of calls, I answered drop No. 30, the cleaning room, and got the following excited message, 'Tess, call the Police Department, Fire Department and the D. L. & W. carshops—have the fire whistle blown—there is fire in this building which is getting away from us!'

"I shouted to the men in the office and they all rushed out to the fire, leaving me alone. I worked on these calls, knowing that if I didn't nobody else would, and glancing out, saw the fire spreading rapidly.

"My first thought was to save the lives of the 1,700 men in the different buildings, and I was calling them up when Mr. Bunnell, who had been one of the first to rush out to investigate, flung himself in and I established a connection for him over the tie line to the New York office. While he was talking the first shell struck the building and past about five feet from where we were sitting. That gave me an awful scare. Mr. Bunnell again went out, leaving me alone, and I would have given up if I had not heard the voice of the central office operator on the line, who was passing the calls for outside help as fast as I could give them; all the while I was getting building after building in turn and spreading the alarm.

"By this time things began to hum. Shells were dropping all around and I thought every minute would be my last. About a dozen buildings were now on fire, and I had completed all calls. No more were coming in and I started for the door without coat or hat. Just then three of the boys who had mist me appeared in the office doorway. One of them shouted, 'Come on, Tess,' but I couldn't walk. My courage left me and I needed their assistance to get out. They picked me up, wrapt a big coat around me, and rusht for the gate, shells dropping all around us. It was an experience I never want to tackle again. The fire was bad enough, but the constant explosions unnerved me."

The "Wireless Wiz" and the Card Sharks

By THOMAS W. BENSON

While the rest of the people along the Atlantic Coast were worrying about man-eating sharks, the "Wiz" was tackling the problem of card sharks. His success with the latter almost led him to tackle the former, but the field seemed overcrowded.

It came about in two ways. One evening he heard a visitor telling his mother how

" . . . but the 'Wiz' had already turned his oxy-acetylene torch on the door and slowly but surely ate his way thru it. . . . At last the door burst open and the officers rushed into a scene so different from that which had greeted the Wizard's eyes, but a short time before. 'You are trapt,' the Captain's stentorian tones rang out."

her oldest boy was gambling too much. He was throwing away all his money on games of chance and was losing consistently. She could not make him pay any attention to her and as a result worried greatly about his morals.

The real cause of the "Wiz" tackling the job was another call from Captain Duffy of Headquarters.

"You see, Jim," he said, "we know there is gambling going on. Rumors have reached us repeatedly thru various channels, but nothing definite could be learned. Now I want you to locate the place and get the goods on them. No, I think you will have to do this for glory," he finished, answering the Wizard's unasked question.

"That's all right, Cap," the Wiz laughed, "I was fully repaid for the trouble I took with those counterfeiters, so I won't ask for any reward this time."

Duffy left shortly to allow the "Wiz" to think it over. He was deep in the subject when I broke in and derailed his train of thought.

"I have one clue," he was speaking slowly as if every word was an effort, "Joe Culver is gambling a lot; by trailing him, we can locate the place, but I'd like to get in and see if the game is crooked. I have it," he continued, "I'll ask him, or rather let him, take me there."

Thought was father to the action and he called Joe on the 'phone and asked him if he could come around the following evening. The reply was satisfactory and the "Wiz" smiled to himself and yawned, the signal that meant "good night."

The next day the "Wiz" was busy getting some apparatus together. He made a coil of wire that would fit around his waist easily. He took an old glove and fastened contacts on the tips of the first and second fingers. He then took an old watch he had discarded some time previous and removed the mechanism. In its place he put a special telephone receiver he had made and run one wire to the case and the other to an insulated contact on the stem. The face and hands were left in the watch and the stem soldered so it would not move.

When Culver called that evening the "Wiz" told him what he had overheard Mrs. Culver say, and told him he was going with him to see if the game was crooked.

Joe protested at first but the "Wiz" induced him to lead on. If the game was crooked it was only right that Joe should be warned.

After walking for several blocks they went into a small saloon. Joe ordered a drink and the "Wiz," watching closely, noticed that he crossed two fingers as he lifted the glass to his lips. The bartender nodded and spoke a commonplace and Joe made for the back room where a man approached, shook hands, and escorted them up-stairs.

At the landing they turned to the left, where Joe gave a certain series of knocks on a door which appeared to be made of wood, yet the "Wiz" noted it was of steel, grained to give the appearance of hard wood.

They entered a large room which was completely surrounded by a solid wall. The "Wiz" surmised that it was a room built inside another and made of steel. A ladder up the further end indicated a means of escape, should necessity arise.

Scattered around the room was a number of tables at which games of the good old American game of *poker* were going on. Clusters of lights were arranged near the ceiling which illuminated the room brightly.

Joe had no trouble in getting the "Wiz" in, since he was a habitué of the place

and well known to all.

The "Wiz" glanced around and advanced to a table where quite heavy stakes were being put up and watched the game for several minutes. The players seemed to be old hands, for only the necessary words were spoken to indicate their actions, their faces being as blank as so many stone images.

The "Wiz" took out his prepared watch and glanced at it, noted it was probably wrong and put it to his ear and appeared to listen. Taking it between his fingers he gave it a rotary motion as if to start it and replaced to his ear, when he heard the buzz of a wireless signal. His face indicated nothing unusual, but he swore softly under his breath apparently at the watch, but more likely at the contemptible cheater at the table.

Next the "Wiz" began to examine the room carefully from the corner of his eye to determine how the signaling was accomplisht. An almost imperceptible flash from the filigree work around the base of one of the lighting units attracted his attention and gave him the clue.

Somebody was up there looking thru the open work with a pair of opera glasses, reading the cards and signaling them to a man at the table.

Meanwhile, Joe had sat in at one of the tables and was losing regularly. His available cash was low, so he arose shortly with an oath.

The "Wiz" called him aside and whispered that the game was crooked and outlined the method they used. This drove Joe into an uncontrollable rage and pulling a gun he let drive at one of the filigreed lamp bases. Joe then sprang on a table and shouted—"The game is crooked, they have spies behind that open work looking at the cards," then springing down he overturned a table, but nothing was apparent as to how the signals reached the man at the table.

As a roar of anger arose from the players, the lights were switched out. The "Wiz" seized Joe and pulled him to the ladder leading thru the ceiling and they ran up into a low chamber. Using his flashlight the "Wiz" saw several men moving around and flashing his "gat," he covered them. "Which way out, quick?" he ordered and one pointed to a trap door. Pushing this up they found themselves on the roof of the building.

They raced along the row of houses trying the trap-doors in the roofs till one yielded. Diving down, they ran thru the house to the front door. A man tried to stop them, but a glimpse of the gun was enough. He agreed they had a perfect right to be there.

Rushing into the street the "Wiz" had recourse to his whistle and two officers answered his signal. "Let no one escape from that building," he ordered, "while I 'phone for reserves," running to a store across the street and getting the night sergeant on the wire.

Time was precious and the reserves knew it, as they came clanging up in their high-powered car. It takes longer to describe these things than it does for them to happen. While the gamblers fought in the steel room, the "Wiz" placed men to guard every entrance as well as the roof.

"Hold them," he ordered, "till I return. That door is of steel and we can't get in, but I will." He sprang into the auto that had brought the reserves and ordered the driver to take him home. Rushing into his "lab" he picked up two metal cylinders, a pair of goggles and a peculiar looking tool to which was connected two rubber pipes.

Returning to the car he attached the rubber pipes to the cylinders as they sped back, and as he jumped down he looked a strange sight indeed. The tubes under one arm, while a hissing white flame gushed from the tool in his hand and a pair of goggles covered his eyes.

The captain led a detail of men into the saloon, which was deserted in the excitement, up the steps and pounded on the steel door with the butt of his service revolver, ordering it to be opened in the name of the law.

No reply came from beyond the panels but at that moment the sound of distant shots rang out. "They are escaping to the roof," roared the cop. "For God's sake do something." But the "Wiz" had already turned his oxy-acetylene torch on the door and was slowly but surely biting his way thru it.

The shots rang out again but the "Wiz" was intent on that thin knife of flame, which was cutting its sputtering way up the length of the door.

It seemed ages before he was half way thru and another century must have past before it reached the upper edge.

At last the door burst open and the officers rushed into a scene so different from that which had greeted the Wizard's eyes, but a short while before.

At the far end of the room the gamblers

(*Continued on page 911*)

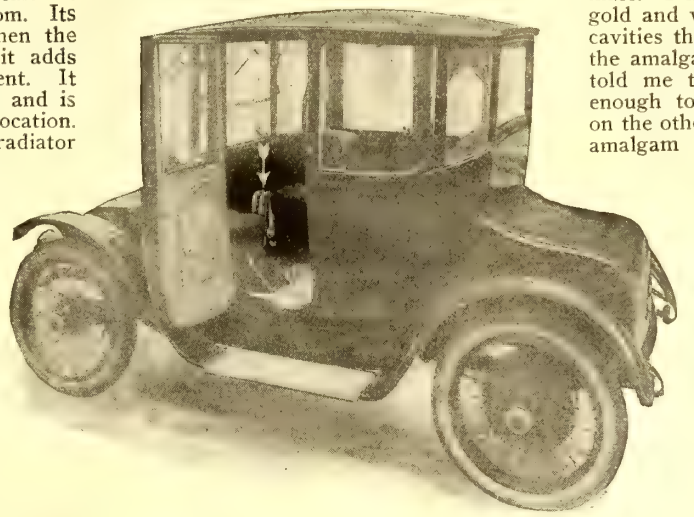
ELECTRIC RADIATOR FOR AUTOS.

The electric radiator here shown installed in an automobile is connected directly to the storage battery of the electric car. It is inconspicuous and takes little room. Its use of current is nominal and when the car is charged on monthly rates it adds nothing to the expense for current. It can be installed in any electric car and is placed securely in any convenient location.

The unique and highly efficient radiator looks like a small steam radiator. You have only to turn a switch and the radiator will quickly bring the car to a comfortable temperature. The radiator is not in the way and is rather an ornament than otherwise.

Changes have been made in the type of fittings used so that the heavy external cast-iron parts are now replaced by prest steel. This change increases the sensibility of the radiator, giving quicker response to the application of energy, permits a 20 per cent reduction in the net weight and gives a higher temperature rise per watt of energy expended.

The essential feature of the construction of the radiator lies in the fact that the heating element is placed in the hollow base of the radiator and is immersed in a non-oxidizing fluid with which the interior of the radiator is almost filled. When the radiator is connected to an electric circuit of proper voltage the heating element gets very hot. This heat passes into the surrounding fluid, which as it gets hot, rises towards the top of the radiator and thus a circulation is maintained and the fluid in the radiator constantly circulates up from the heating element and then down on the side of the radiator section, back to the element, then up again, etc. These electric radiators are available in sizes of 500, 750 and 1,000 watts capacity and can be furnished for any voltage, alternating or direct current.



Something New in the Automobile World—a Small but Highly Efficient Electric Radiator, Which Can Be Connected to the Battery of Electric Vehicles.

WILL ELECTROLYSIS DESTROY TEETH?

Is there any basis for the assertion that when a person has several tooth cavities filled with different metals, say some with *amalgam* and others with gold, there is likely to be rapid decay of the teeth due to the electrolytic action between these different metals? I have heard this statement made positively by some dentists and flatly denied by others, says a querist in *Electrical Review*, to which the answer is given:

Such action depends entirely on how the *amalgam* is made. If the mixture is thoro, there is no reason for it to disintegrate. Where electrolysis has occurred it may be safely said that the mercury in the amalgam was not properly incorporated in the mass. I have one tooth that is filled with gold and with amalgam; so close were the cavities that the two metals touch. Before the amalgam filling was placed, the dentist told me that the tooth was not strong enough to warrant filling with gold, but, on the other hand, he was afraid to fill with amalgam on account of electrolysis. To discover, if possible, and to prevent electrolytic action we experimented with voltaic piles made of gold and amalgam with blotters wet with sodium chloride and later with acetic acid. There was not a measurable electromotive force where the amalgam had been properly made.

Where the amalgam is not made properly, further chemical action, not electrolysis, causes the disintegration of the tooth filling. Even a poorly made amalgam filling will last four to six months, if the tooth does not decay around it. Cleaning the mouth thoroly once a day will keep the teeth clean enough to prevent decay. In the so-called electrolysis cases the cause is generally decay around the filling or chemical action in the filling which latter would occur, regardless of whether the gold was adjacent or not.

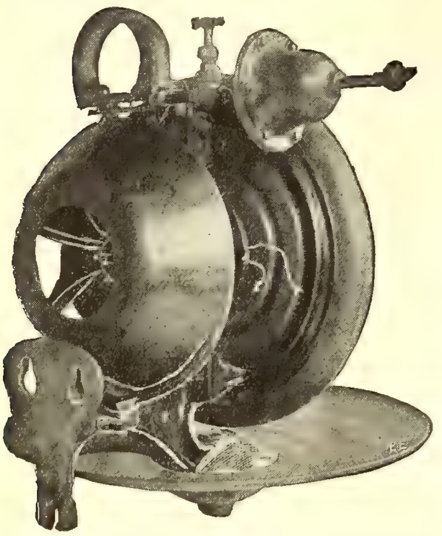
SHORTAGE RADIO OPERATORS.

Recently a Norwegian boat bound from Philadelphia to an English port wanted an operator badly. The position was offered to two Philadelphian operators, but they hesitated at taking chances with German submarines or howling gales, and the master of the craft was forced to pick up a gallant soul from New York.

AN ELECTRIC MOTOR-DRIVEN HUMIDIFIER.

By Frank C. Perkins.

The illustration herewith is that of an electrically operated and automatically controlled humidifier, developed at Char



New Electric, Motor-driven Humidifier which Automatically Moistens the Air Whenever It Becomes Necessary.

lotte, N.C. It is pointed out that in such establishments as bakeries, feather factories and tobacco houses, where a certain degree of moisture in the atmosphere is an absolute necessity for the proper preservation of certain materials the use of a moisture-producing device or humidifier is highly essential.

This device is electrically operated, automatically controlled and entirely self-contained. The humidifier is mounted on the wall or columns of a room or suspended from the ceiling and the control apparatus is provided with a deflector which is in the regulator chamber, and when atmospheric conditions so require the deflector deflects the entering water into an overflow.

It may be stated that the water enters from above and passes into the regulator chamber, whence it flows directly (when the automatic control permits) to the center of a rapidly revolving disk, from which it is thrown by centrifugal force against the teeth of a copper grid at the circumference of the disk, where it is broken up. Back of the disk is a fan which forces outward all particles of moisture which are sufficiently fine to float around the edge of the case. The speed of the disk is such as to put a heavy pressure on a very thin film of water, and this film strikes the teeth of the grid with sufficient force, it is claimed, to break up the water completely into very minute particles.

The revolving disk is 16 inches in diameter and the horizontal drip pan 24 inches. Any number of *heads* may be installed. In one large textile plant, for instance, 422 heads are in successful operation, humidifying approximately 8,000,000 cubic feet of air space. Humidifiers of the type shown are particularly in demand in cotton, woollen, silk and flax mills. They are also being utilized in considerable quantities not only in this country but also in Canada, Mexico and Cuba in tobacco-leaf and tobacco manufacturing houses.

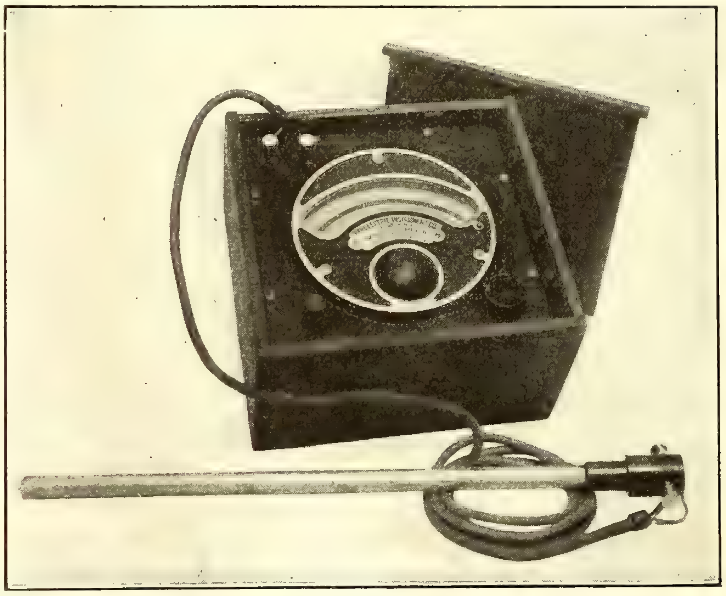
It is of interest to note that these electrical devices are especially useful in the sponge and dough rooms of bakeries, since they automatically maintain the proper humidity desired, thereby preventing the crusting of dough and causing the dough to rise uniformly and produce more loaves to each barrel of flour. By the use of cold water the temperature of a dough room may be reduced 10 degrees or more. Lately also the machines have been employed for humidifying and deodorizing theaters.

It is claimed that in mines they can be used to prevent explosions of dust. In furniture and automobile factories, the machines are utilized in fuming and varnish rooms and in printing establishments to prevent the curling of paper caused by dryness and also to prevent sticking caused by static electricity.

AN ACCURATE ELECTRIC TEMPERATURE INDICATOR.

The new electric temperature measuring instrument here illustrated is called the Pyrovolter. It combines the characteristics of the voltmeter, with the accuracy of the potentiometer, and was designed for the specific purpose of making the readings of temperature independent of the resistance of the thermocouple circuit, which resistance is apt to vary on account of corrosion, temperature conditions, etc.

The pyrovolter, as such, is not the complete measuring outfit but it is the indicator which enables one to read the voltage developed by a thermocouple of any type whatever, whether made of base metals giving a high electromotive force, or of noble metals giving a small electromotive force. The deflection instrument employed is exactly the same for all types of thermocouples and for all temperature-ranges and consist of a millivoltmeter having a strong spring control.



The Pyrovolter—the Latest in Electrical High Temperature Measuring Instruments and Said to Give Extremely Accurate Readings, Because the Deflections Are Due to Battery Current, Not to the Thermocouple Currents.

The additional feature, which permit the electromotive force of a thermocouple to be read independently of the resistance of the thermocouple circuit, consists of a switch operated by a push button, a rheostat and a battery. These parts, all being small, are located inside the wooden case in which the instrument is mounted. The push button and the handle of the rheostat are outside the case and occupy two front corners. The two ends of the thermocouple are attached to two miniature dry cells, a small rheostat and a binding post located in another corner of the case as shown.

The dry cells supply the energy which deflects the instrument, the thermocouple itself not being called upon to furnish any current for the deflection. The rheostat, operated by the handle outside the case, will move the pointer over the scale (calibrated to read in degrees Centigrade or Fahrenheit) of the instrument when the handle is turned. By turning the handle until the pointer stands at the beginning of the scale of the instrument and then pushing the button in the left front corner of the instrument the pointer at once deflects to a point on the scale which indicates the true temperature of the fire end of the thermocouple.

As the indications of the pyrovolter do not depend upon the resistance of the thermocouple circuit, it is not necessary to make the thermocouple wires heavy and of large cross-section, as is commonly done for the purpose of keeping the resistance of the thermocouple very low. Thus wires of small diameter may be used and it is entirely practicable to make the thermocouple wires long enough to reach from the fire end to the pyrovolter.

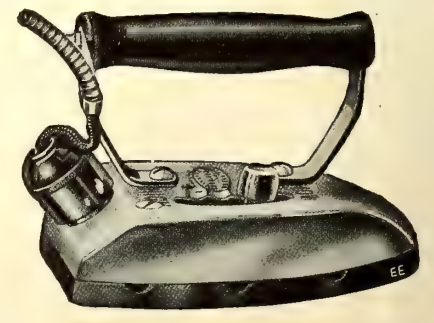
A "Thermos" bottle is supplied with the instrument for maintaining the cold junctions in ice water at 0°C. High temperatures of 1,200° to 1,500° C., are covered by this precision instrument. In the pyrovolter the battery supplies the current for the deflection, not the thermocouple.

AN ELECTRIC REGULATOR IRON THAT SAVES CURRENT.

The Regulator Sad Iron here pictured is made in such a manner that the heat can be accurately controlled while in use, its makers aver, and moreover maintained at any required degree of temperature. Four different heats (five in the larger irons) are controlled by the finger tips of the operator by the simple movement of the Regulator lever on the iron, generating a heat sitable to the daintiest fabrics up to a very high heat necessary for the heaviest damp material.

The ability to regulate the current to produce just the heat desired obviates the danger of scorching, and permits of continuous work at the proper heat for any material.

A saving of 40 per cent in current is effected due to the construction of the heating element.



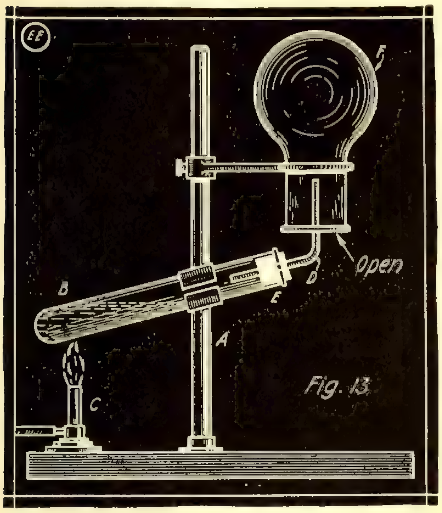
The Electric Regulator Iron That Uses Small Power for Light Ironing or Large Power for Heavy Pieces.

Experimental Physics

By JOHN J. FURIA, A. B., M. A.
Instructor in Physics and Science Master, Riverdale Country School

LESSON THREE.
GASES AND THE ATMOSPHERE.

IN the last lesson we noted that air is a material substance and differs from simple space. It can be weighed and carried about from place to place. It can be compress and expanded and when compress exerts a force. We also



Preparing the Ammonia Gas for the "Ammonia Fountain" by Heating a Mixture of Sal-Ammoniac and Slaked Lime.

found that it was this force of compress air (or of other gas) that makes possible all sorts of explosions, both destructive and beneficial. In this lesson we are to study the air and to see how it differs from space and how it resembles other gases. At this stage it is necessary that we know exactly what is meant by a gas and that we understand the *Molecular Theory* and the *Kinetic Theory* of gases. Matter is generally defined as anything that occupies space. The different kinds of matter are called substances. Substances differ in the way in which they occupy space, and it is this difference that determines their physical state. The three physical states of matter are the *solid*, the *liquid*, and the *gaseous*. A solid has a definite shape or form, and therefore a definite volume. A liquid has no definite form, but has however a definite volume. It can fill a vessel only to the extent of its volume and takes the shape of the containing vessel in so far as it fills it. *Gases have neither definite form nor definite volume.* They tend to distribute themselves in all directions and fill completely any vessel into which they are placed; their only boundaries are the containing walls.

EXPERIMENT 11—

Heat a piece of ice. The ice melts into water. If now the water is heated to the boiling temperature (212° Fahrenheit) it changes into steam. By this very simple experiment we have shown that a solid can be changed into a liquid, and then the liquid into a gas. We must not, however, infer that in order to change a solid into a gas it must first be changed into a liquid. If a few Iodine crystals be heated we notice that they pass immediately from the solid state to the gaseous state. This whole process is reversible, *i.e.*, we can begin with the gas and change it to the liquid and solid state. For example, steam can be condensed into water and then the water can be frozen into ice. This change of state is utilized practically in many ways.

EXPERIMENT 12—

Purifying a liquid by distillation. The apparatus (Figure 12) can be bought made of glass, or can be easily constructed as follows: G and H are two lamp chimneys of identical size, connected together by a straight rubber stopper B which contains three holes. DEF is a piece of glass tubing passing thru the center holes of the rubber stoppers A, B, and C. (The tubing is easily bent into the shape shown in the diagram by the use of a wing top Bunsen flame, as explained in the first and second lessons of *Experimental Chemistry* of the series now appearing in THE ELECTRICAL EXPERIMENTER.) R and S are also pieces of glass tubing; K and L are holes in the stopper B, which must be left open. Steam is allowed to enter D, while R is connected to the water faucet. The steam in passing from D to F is condensed into water because of the cold water which is passing around the tube DEF and out thru S.

IN THE MAY "E.E."

The May issue will be a wonderful "Edison number," including a remarkable interview with the famous inventor and some exceptional photographs of him, including a handsome cover painting in colors.

Baron Münchhausen's New Scientific Adventures—By Hugo Gernsback.

The Sources of Electricity—special feature article illustrating and explaining in popular style, all of the principal known sources of this form of energy.

Electricity's Aid to the Fair Sex—A page of live interest to all women, showing in snappy illustrations how the magic power of electricity has been tamed to iron the clothes, boil the coffee, cook the roast and a host of other things.

The "Strong" High Frequency Coil and How It Works—By Dr. Frederick Finch Strong.

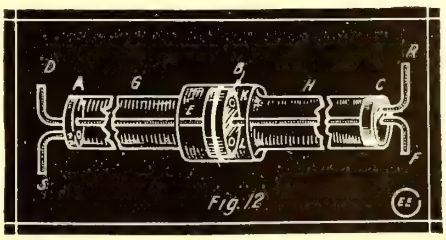
The Washington's Birthday Radio Relay—Results and Prize Awards—By W. H. Kirwan, 9XE.

The Calculation and Measurement of Inductance—Part III of this series by H. Winfield Secor and Samuel Cohen.

Experimental Physics—Fourth paper of the new series—By John J. Furia, A.B., M.A., F.K.S.

Several interesting articles in "The Constructor" Department, including details of an illuminated sulky and harness outfit adapted to parade and stage requirements. It operates on dry cells and was actually built.

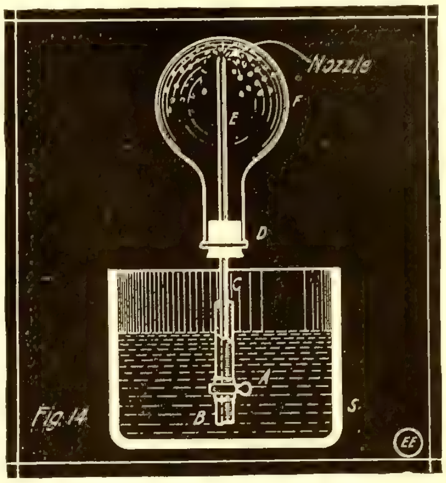
Watch the Radio Department!



Simple Condenser Made from Two Lamp Chimneys, Some Glass Tubing and Three Rubber Corks for Demonstrating the Process of Distillation.

EXPERIMENT 13—

Allow a piece of washing soda to stand in a dry place uncovered for a few hours. We notice that the crystal changes into a powder and if we weigh carefully the crystal before allowing it to stand and after, we find that it loses weight. The loss in weight is explained by the fact that the crystal contained water and the water evaporated into the atmosphere. This shows that a *solid*



The "Ammonia Fountain"—An Extremely Interesting Apparatus Readily Constructed by the Student. Ammonia Gas Causes the Water to Rush Out Thru the Nozzle As Shown.

may very readily contain a *liquid* in it.

EXPERIMENT 14—

Allow a glass of water to stand over night uncovered. In the morning we find that there are many bubbles clinging to the sides of the vessel containing the water. These are bubbles of air. That is we have shown that a *liquid* may contain a *gas* dissolved in it. If it were not for this fact, fish could not exist, because of their need of air or at least of the essential constituent of the air, Oxygen.

EXPERIMENT 15—

Fill four tumblers with water. In the first, place a pebble; in the second, a lump of sugar; in the third, a tablespoonful of red ink and in the fourth a tablespoonful of some oil that is not colorless. After stirring the four we find that the pebble remains as it was, that the sugar disappears (dissolves), the red ink mixes with the water so that the whole tumblerful is red, but the oil remains separated from the water. We conclude that *some solids* dissolve in a *liquid* while others do not.

EXPERIMENT 16—

The ammonia fountain showing the dissolving of a gas in liquid. Part one—The preparation of ammonia gas (see figure 13). Ammonia gas is lighter than water and hence can be collected by the upward displacement of air. Mix about a teaspoonful of ammonium chlorid (sal-ammoniac) with an equal quantity of calcium hydroxid (slaked lime) and place in test tube B. F is a Florence flask, or a beer bottle, or some other glass bottle. D is a piece of glass tubing thru rubber stopper E. C is an ordinary Bunsen flame, and A a ring stand or some other contrivance for holding the test tube and flask in the positions shown in the diagram. As a result of the chemical action in the test tube, ammonia is given off and passes into the flask displacing the air.

EXPERIMENT 17—

The ammonia fountain. Part two—(see figure 14). Holding the flask F in the same

(*Continued on page 941*)

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

H. Gernsback, Manager *W. H. Kirwan, Master of Radio Relays*

The Washington's Birthday Relay and the Q. R. M. League of America

By W. H. KIRWAN, (9XE)
Master Radio Relays, Radio League of America

ALL of you have probably read in this magazine about the Washington's Birthday Relay. The amount of work in connection with one of these Relays is practically unknown to most of you, but the results of them are most gratifying as it interests new talent thruout the country and, moreover, tends to bring to the public notice the real worth of the wireless amateurs in the United States.

A certain magazine in the East, which surely cannot have the real interests of the amateurs at heart claims that there is a danger signal up and that if you did not join its crowd, all of our licenses would be taken away. When things get so bad in the wireless world that a few struggling nonentities can convince intelligent Americans that there is any danger of our licenses being taken away from us, then we all should lose them, as we will not have enough spunk to operate anything.

There is no danger signal up and there is plenty of room in this country for more than just one select crowd of "air hogs," who are nothing more or less than a specimen of the "end seat hog," and we know enough about them to know that most of them are vacuums and need not cause us any worry outside of an extra effort occasionally to push them out of the way. We are organizing a *Q. R. M. League of the United States* and every state will have a captain, three lieutenants, nine sergeants and a number of willing helpers to act as privates. Now, let's get together and form a real army of workers and see if we cannot, by getting the opinion from all the different states, agree upon a working basis for all stations with justice to all. This we know is necessary and you need have no fear of the calamity howlers who claim that the minute you look cross-eyed you are going to lose your license. Use your head and put these pests on the shelf, where they really belong. Watch this magazine closely, as all of the states, as soon as organized, will have the names of their various representatives printed in this magazine, and we have the support of some of the best thinkers in the country to help us.

This magazine has done more for the amateurs than all the rest put together, as it originally championed our cause and has been working incessantly ever since. It has championed the Q. R. M. League and we know that it will put this across the plate with the same determined effort as marked its other activities in our behalf.

The slogan is "JOIN THE Q. R. M. LEAGUE NOW." A great many of the states are already organized, and we have some very willing workers in every portion of the country.

The Washington's Birthday Relay was handled by men and their stations who are cooperating in the formation of this League and you can readily see from the names publisht in this magazine that you will be honored in joining with some of the most progressive amateurs in the country. There is lots of work being done, of which we hear little, and our brothers on the Pacific Coast are having the time of their lives with Q. R. M.*, but, thru it all, have done some remarkable work.

Now, just for a little gossip of the stations around 'Frisco and from whom the writer heard too late to publish in the last story to this magazine. Gilbert of Pomona, Cal., and our friend, Winser of Bakersfield, have installed a large power station 100 miles from home, but were on the job for the relay. Bunting of Centerville burned out his transformer and had as substitutes in the relay—6FT and 6BY. He participated in breaking QRM however.

Word has been received from Emerson, 5 DU, in Dallas, Texas, that he has worked Higgy of Phoenix, Ariz., 6 DM, and both are making tests early every Friday morning. L. S. Hoyt, 6 SI, of Hayward, Cal., reports hearing 5 DU regularly. Turner, 6 ABR, of Los Angeles, states he has actually worked with 9 ZF in Denver, Colo. This is in keeping with the best work that has been done in the Central or Eastern parts of the United States. It is too bad we did not hear from these stations before lining up the schedule.

We call all of your attention to 6 DM, of Phoenix, who works regularly 6 BY, 6 FT, 6 WZ, who are in the neighborhood of 700 miles from him. 6 AAG, 6 SR, 6 EA, 6 RG, and 6 ABR are about 350 miles and, of course, 6 DM has no trouble in working them.

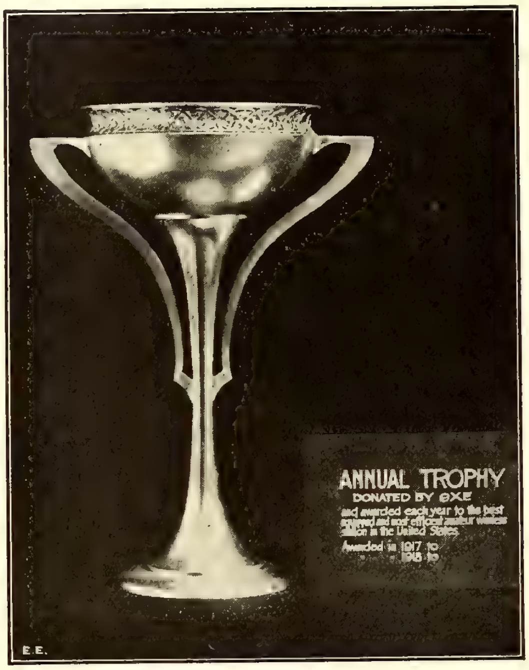
The following stations are practically close and have no trouble whatever in working thru Q. R. M. at any time. 6 EA, 6 ABR, 6 AAG, 6 ZW, 6 NL, 6 AY and 6 RG are close enough to work each other at all times, but have no trouble in working any of the following stations, which are at least 200 miles from them, as follows:

6 BY, 6 HO, 6 TR, 6 SI, 6 IB, 6 AU, 6 SH, 6 SX, 6 AHN, 6 WZ, 6 BJ, 6 FT, 6 AGW and JS.

This Western coast is surely the country of magnificent distances.

Another part of the United States that few of you are acquainted with is Colorado, which has one of the largest and best equipt radio stations in the Colorado Wireless Association at the Y.M.C.A. Building in Denver. Mr. W. H. Smith, the chief operator, received the first commercial

(Continued on page 942)



We present herewith a photograph of a large silver trophy which will be given to the best Radio Amateur Station. It stands 21" high and 13" across, and will be suitably engraved.

It is to be presented to the best equipt and most efficient amateur station in the United States, after the end of the working season. A committee will be appointed from the various clubs thruout the country, to decide who is entitled to it and to hold it until next year, when soemone else may be awarded it. Holding it two years in succession will mean that it belongs to the station holding it. This is Mr. Kirwan's timely idea to have the amateurs perfect their outfits and numerous points will be taken into consideration when awarding it, as those amateurs who continually "QRM" will not be considered.

Mr. Kirwan has gone to some little expense in this matter and trusts that he will have the cooperation of all loyal Radio-bugs. The awarding of this prize will undoubtedly cause considerable interest in Bugdom.

**For the benefit of our lay readers: Q. R. M. is the abbreviation term accepted by the International Radiotelegraphic Convention for interference. If one operator asks Q. R. M.? of another it means "Are you interfered with?"*

Editor's Mail Bag

"E.E." TO THE FRONT.

Editor Electrical Experimenter:

Mr. Kelly, a locomotive engineer of this locality, was in our office to-day and spoke of some articles that were publisht in your last issue. He also said that your paper was coming to the front and that he believed would soon take the lead of all technical magazines. Thought this might interest you and that is why we have mentioned this instance. Thanking you very much for past courtesies, we remain,

THE ELEC. ACCUMULATOR CO., INC.
Per FREDERICK W. REEVES, Pres.
Pittsburgh, Pa.

[*Comment such as this, coming from an expert source, cannot but spur us on towards making this journal the greatest of its kind.—Editor.*]

THE BRITISH LION ROARS!

Editor The Electrical Experimenter:

As a new reader of THE ELECTRICAL EXPERIMENTER I am writing to tell you what I think of your paper.

Comparing it with other papers in England, of the same class, I consider it the best paper I have come across. In fact, so far it has proved just the sort of paper that I wanted on that subject (electricity).

I am not filling in your voting blank, as your articles are all to my liking. The only two things that I do not like are not down on the voting blank.

They are the size of the journal, which I think is too long as well as a little too wide. The reason I think so is because it is much more convenient to put a paper which is smaller and which could be thicker in your pocket, than one which is large. You may wonder what I want to put it in my pocket for; well it is, so that I may read it on my way to work in the train in the morning, or any other time so that this time may not be wasted. The second objection is that of having to turn to the end of the book for the other part of the article. I would much sooner that the articles continued straight thru the paper and not at the end. I am sending the money to have THE ELECTRICAL EXPERIMENTER sent to me thru your agent at Liverpool.

Wish you success and hope you will have many new English readers for your paper.

GEOFFREY WIDDOWSON.
Carlton, Nottingham, England.

[*Every once in a while we have criticisms of this kind, so we will explain. Where would our many, beautiful, large wash drawings and illustrations be if the pages were smaller? Also, smaller magazines do not lay "flat" when opened up, and the hand tires while holding such magazines. As to the articles continuing in the back among the "ads" this is done so that the reader cannot fail to see the "ads." Always remember that the magazine could not exist for two months if it were not for the advertisements. The advertiser paying at the rate of $128.00 for a page deserves some consideration. It is the practise of the largest and best publications, and the readers lose nothing by submitting themselves to a little inconvenience.—Editor.*]

AS TO LATE DELIVERY.

Editor The Electrical Experimenter:

One day, while visiting a friend of mine, he gave me an ELECTRICAL EXPERIMENTER, issue of November, 1916, and ever since I have become a "bug" on wireless and am making my own apparatus as fast as I can. I am an old time railroad operator and know something about telegraphy. I am an enthusiastic reader of the EXPERIMENTER and I would rather miss my meals than miss it, but why is it we get it so late here in Pittsburgh, when it is issued, as you say, the fifteenth of every month. We sometimes don't get it for a week or ten days after the fifteenth.

I enjoy reading every page of it and the information one can get out of it is worth ten times the price per issue. Wishing you the success you deserve, I am

M. H. BREX.
N.S. Pittsburgh, Pa.

[*We are receiving a great many complaints as to late delivery lately, especially from our many newsstand readers. Unfortunately we cannot remedy this now on account of the existing country-wide train blockade. All freight moves exceedingly slow nowadays, and this condition will probably prevail until the end of the war.—Editor.*]

Under this heading are publisht communications from our readers of general interest to all concerned. In order that letters shall receive proper attention, we earnestly request you to make them as short and concise as possible. This is essential on account of the great amount of mail received daily.

No attention can be paid to unsigned communications, but on request we will withhold the correspondent's name.

EDITOR.

AN INDEX FOR "E.E."

Editor The Electrical Experimenter:

I am writing this letter in the form of a suggestion. It seems to me that there is great need for an index and cross record for all the articles appearing in your magazine. As it is now, it takes hours to find an article that one has seen publisht, while, if a monthly index were publisht, and this bound together at the end of the year, a very good reference work for the amateur could be made of the EXPERIMENTER. A booklet containing all the questions and answers to date would also be in great demand.

I should also like to see appear in the EXPERIMENTER more Audion hookups for undamped waves with as little apparatus as possible.

FRANK SAHLMANN.
Manhattan, Kans.

[*We have been thinking about an index for some time and we have had a great many similar requests to the above one. But as not every reader desires an index, and as it obviously would take up a good deal of space which we would rather fill with text, we decided to print a separate index in form of a small booklet. This index will cover every article publisht in the "E.E." since its first number. It will be ready April first. Price 10 cents prepaid. See our advertising section in the May issue for further particulars.*

A 25 cent book containing all "Questions and Answers" publist to date will be issued by us at an early date.—Editor.]

AN URGENT NEED.

Editor The Electrical Experimenter:

Ten years ago I timidly advocated and prayerfully urged the use of car-axle power for ventilating and lighting cars and was laughed at and scorned by the railway and other so-called experts of the time. Forgetting the down-grade waste of power, they advanced the theory that such a scheme would put just that much more work on the engine so, therefore, it had better be done direct. And they did light the cars by direct engine power.

Now, however, that axle-power has come into its own and is at last acknowledged as the best and cheapest means of lighting cars, why can't our experts go a step farther and put in a little individual ventilating plant in each sleeping car, at least, and operate it with axle-power too? A system of fans pulling air through a fine screen and blowing it over heating coils in winter and the ice tank in summer, something, anything to secure a little better air and regular temperature than we have now, when such details are left to the vagaries of a sleepy Senegambian. Especially are we interested in securing a little better ventilation of the berths, the coops in which we are almost hermetically sealed in at night.

Such is again the prayer of a fresh-air fiend, a fellow who sleeps out-of-doors at home but who has to spend many a night in the aforementioned air-tight coffin-like coops. F. W. FITZPATRICK.
Omaha, Neb.

[*This is a capital idea, and as practical as it is excellent. Besides the expense should not be very large, especially when a new car is built. We commend the idea to our railroad officials.—Editor.*]

FROM THE RADIO CLUB OF FLINT.

Editor The Electrical Experimenter:

The series "The How and Why of Radio Apparatus" is the best one ever publisht. It is what we have been looking for for a long time to present to the beginner. We have lost many members of this Club on account of not being able to interest the fellow just starting in.

The article on the induction coil will be read at the next meeting and I hope many other similar articles will follow.

R. J. FREWLEN.
Flint, Mich.

[*We had not thot of it that some of our articles might make good lecture material, but evidently such is the case. Appreciation of this sort spurs us to greater efforts, and we assure the Radio Fraternity that we will not be found wanting.—Editor.*]

WOMEN EMPLOYES IN ELECTRICITY WORKS.

The Local Government Board has forwarded to local authorities and electric supply companies thruout the country a memorandum prepared by the Home Office and Board of Trade dealing with the substitution of women for men in municipal services, particularly in electricity undertakings, says *The Electrician*, London.

For some time past the Marylebone electrical supply has been employing women to carry out the duties, among others, of junior engine drivers, volt regulators, lamplighters, meter testers and maintenance attendants.

WHAT THEY LEARNED.

A visitor to a Sunday-school was asked to address a few remarks to the children. He took the familiar theme of the children who mocked Elisha on his journey to Bethel—how the young ones taunted the prophet, and how they were punished when two she-bears came out of the wood and ate forty-two of them.

"And now, children," said he, "what does this story show?"

"Please, sir," came from a little girl in the front row, "it shows how many children two she-bears can hold!"—*Tit-Bits.*

Giant U. S. Radio Station at San Diego Ready

IN the presence of prominent San Diego citizens and Army and Navy officers the great Chollas Heights U.S. naval radio station was formally placed in commission on January twenty-sixth, with the exchange of greetings between Mayor E. A. Capps and Josephus Daniels, Secretary of the Navy, and William Kettner, Representative in Congress.

The Chollas Heights station under favorable conditions can flash messages 12,000 miles. In preliminary tests code messages flashed in Germany have been picked up in this station. Command of the new station will be directly under Lieutenant John Ashley, superintendent of the naval radio communication service of the navy between the Atlantic and Pacific coasts.

The navy wireless stations at San Francisco and Puget Sound have been in service for some time, but they required such tremendous power to communicate directly with Arlington that anything like regular communication between them has been infrequent and the great volume of naval orders and communications have been sent by ordinary telegraph.

At San Diego there has been erected an enormous station that is more powerful and more modern than any other in the service. Its equipment will be so adjusted and of such power that communicating with Arlington will be a nominal service, not an extraordinary service, as is the case with San Francisco and Puget Sound. It will be the most powerful station in the world with the possible exception of the two German stations that send to Sayville and Tuckerton.

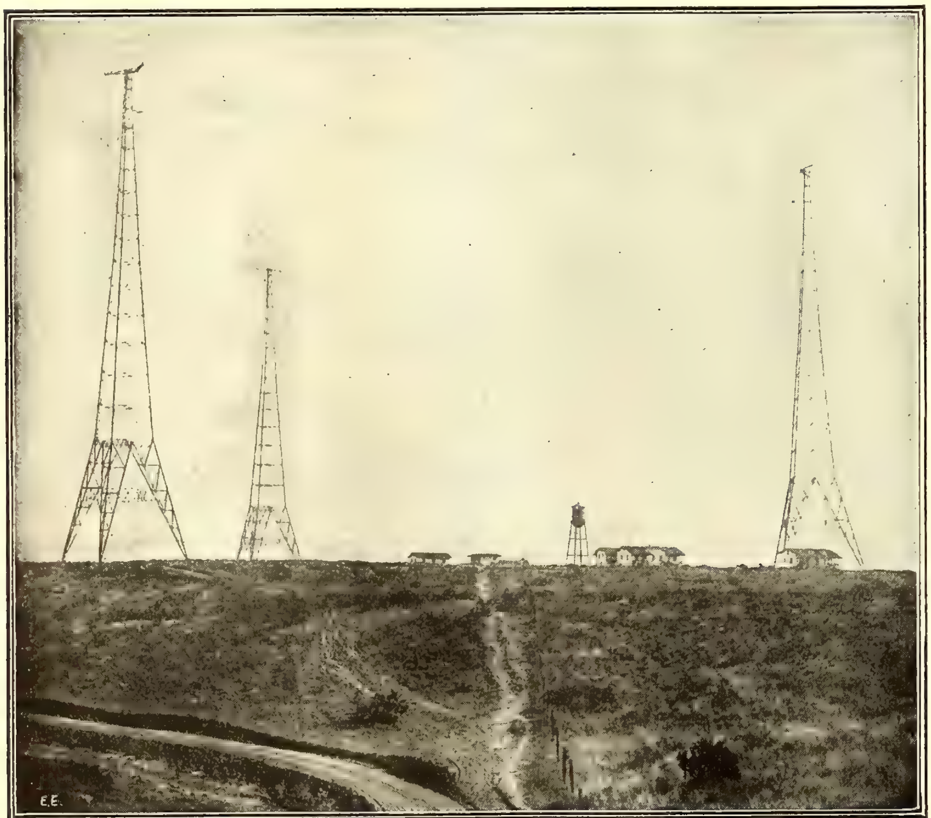


Photo by Central News Photo Service.

A View of Uncle Sam's New $300,000 Naval Radio Station at Chollas Heights, Near San Diego, Cal., Which Was Placed In Commission on January 26th Last. The Commanding Officer's Quarters Is Seen at the Base of the 600-Foot Tower on the Right.

service for the Southern California district.

The new government wireless station gave a demonstration of its power when the operators on duty talked with the Arlington station, with Melbourne, Australia, with Panama, and with Nome, Alaska, and also Honolulu. At the same time it overheard French operators at work on the island of Papeete, in the South Pacific. Thus with one relay the government at Washington can talk with Australia and farthest Alaska. The San Diego station hopes to be able to reach Europe by means of its powerful instruments when they get properly tuned up.

Its opening marks an era in the direct

The three towering aerial masts rise to a height of 600 feet, and involve 1,000,000 pounds of structural steel in their make-up. The aerial wires alone weigh 16 tons. The aerial towers are 1,100 feet apart and form a huge triangle. Triangular in form, the masts measure 150 feet between the legs at the base and 8 feet across the top. They rest on gigantic insulators at the base. The *ground* connection required 25 miles of piping and copper cable. Most of the ground will be kept constantly damp by means of the piping. The power plant comprises a 300 H.P. 2,200-volt, 60-cycle induction motor driving a 200 K.W. 1,000-volt, D.C. generator, which supplies a Federal-Poulsen arc transmitter of this rating. The tuning helix for the arc is 14 ft. in diameter and 11 feet high. The station is erected on a land reservation totaling 72 acres.

AUTO BATTERIES SUPPLY RADIO SET IN EMERGENCY.

The following is an extract from the report of Radio Operator Willard Ferris, of the steamship *Carolina* of the Goodrich Transit Co., which met with an accident on December 3, 1916, running aground on Stony Creek Reef and springing several plates. The vessel is voluntarily equipt with radio apparatus and is not supplied with an auxiliary source of power supply:

"The power went off at seven p.m. and the Manitowoc station called at frequent intervals until ten p.m., and from that time until eleven p.m., the Ludington and Milwaukee stations called, but I was unable to answer them as there was no power. About eleven o'clock, with the permission of the captain and the assistance of some of the crew, I removed the storage batteries from the six automobiles which were on board.

"I wired these batteries in series, obtaining a total voltage of 36. The transmitter was of the one-half kilowatt, 120 cycle, panel type, and by adjusting the rheostats for full power and using six plates in the quenched gap a reading of one-fourth ampere on the hot-wire ammeter was obtained and communication was established with Ludington, a distance of about 75 miles.

"It was necessary to short circuit the automatic starter, as there was not enough power to raise the solenoid, and to substitute a wire for the generator field switch, in order to disconnect the motor running the quenched-gap blower and save all the power for the operation of the motor generator. The batteries were restored to the automobiles the following afternoon when the cars were placed aboard a relief vessel."

RAILROAD MAY OPERATE TRAINS BY RADIO.

If experiments now going on at the operating headquarters of the Frisco railroad in Springfield, Mo., are successful, wireless telegraphy may become a valuable asset in the operation of trains over that system.

H. D. Teed, superintendent of telegraph of the Frisco, has installed a wireless apparatus at Springfield and messages have been heard from government stations at Arlington, Key West and from a fruit dispatch boat on the Gulf of Mexico.

A year ago the wire service of the Frisco was badly interrupted by sleet and floods, according to an announcement from the general offices in St. Louis. Since then Mr. Teed has been experimenting with wireless, and in many ways it is said to have proven successful.

California Youth Invents Radiotelephone System

EARL C. HANSON, of Los Angeles, California, has earned a place in the hall of fame by inventing a compact radiotelephone system having unlimited possibilities.

Mr. Hanson, comparatively, is a mere youth, as he recently celebrated his twenty-third birthday. At the age of ten he began his experiments. To-day he is still experimenting, but patent papers awarded by the United States government, following several years of litigation wherein Marconi and other wireless inventors figured, are positive proof that he has arrived at the station known as "Success."

By the use of apparatus invented by Mr. Hanson, it is now possible to send a wireless telephone message from an automobile going a mile a minute, to a point five, ten or a hundred miles distant.

With this apparatus two of Uncle Sam's warships can carry on a wireless telephone message, at any distance, use plain English

The Accompanying Pictures Show a Variety of Ways In Which the New Hanson Radiotelephone System Can be Used. Above, a Patrolman, Using the Wireless Telephone While on His Beat, to Answer a Call from Headquarters. Its Possibilities in This Direction Alone are Limitless.

At the Right, a Portable Radiophone Field Set, Which Could be Used by Scouts During War Times. Note the Extreme Compactness of the Hanson Apparatus, Enabling it to be Carried About in a Hand-Bag or on the Back.

The Hanson Wireless Telephone Laboratory, Showing Tuning Cabinet and Special Compound Heavy-Current Microphone. The Victrola at the Extreme Right Is Used for Transmitting Music via Wireless.

instead of a code, and feel assured that no other wireless station can pick it up.

These are only two of many uses to which the invention of this Los Angeles youth can be put, but many others equally valuable will immediately suggest themselves.

With this apparatus in your reception-room it is possible to reproduce any song or instrumental selection your guests may call for. If one of them suggests he would like to hear Caruso sing, the great tenor will oblige before the guest has finished his request, and this without the host leaving his chair, or making a move, or uttering a word. Here is the explanation:

From another room, or from another house, some one operating a phonograph, hears the request by use of a dictagraph placed back of a picture in the reception-room. The machine is started, the wireless apparatus conveys the music to an instrument in the reception-room called an *audio-tone*, and the guests listen to the sweet tones of the singer.

With one of these instruments in your auto, and another in your home, you can call up your wife when you are well on the way, and tell her to put the tea kettle on. Also, she can reverse the call, and tell you to go back to the city and get a spool of thread and a pound of butter, which of course you have forgotten.

You can talk to the man in a flying machine a mile high, and fifty miles away. Or he can call you, as the case may be.

Recently the writer visited this young inventor, and enjoyed an hour or two with him in his laboratory. Worden Crumley, a young friend of Mr. Hanson, volunteered to take charge of the sending instrument, and Mr. Hanson and the writer went for a walk around the block, carrying with us a small box about ten inches square and two inches thick. Two receivers were attached to the box with insulated wires, about five feet long. With the receivers to our ears we strolled down the street, and listened to a wireless reproduction of one of McCormack's great song hits.

Then, to vary the program, Mr. Crumley told a story by wireless, and every word was heard as distinctly as tho coming over the ordinary telephone.

This device may also be used to advantage by patrolmen, regardless of whether they are located within the city or in outlying districts. While making his rounds the patrolman may carry his combined sending and receiving set on his bicycle or slung over his shoulder, a receiver at all times being attached to one ear. A resident on this patrolman's *beat* telephones by wire to Central Station that a robbery is being committed close to his home and that help should be sent at once. The operator at Central Station immediately calls the patrolman by *wireless*, no matter at what part of his beat he happens to be, and he at once hurries to the scene, which may be but a few hundred yards distant. This does away with sending men from Central Station for miles into the suburban districts to answer whatever calls may come in from those sections.

Municipal wireless phonograph concerts may also soon be a reality. For these a single centrally located sending station would be necessary, the waves from this having a radius of the entire city. At a given time each evening all the residents of the city might, by the use of a receiver and ear tubes or a receiver connected to a phonograph horn, enjoy the concert as it is played into the transmitting apparatus at the sending station.

Mr. Hanson's wireless telephone differs from any other invention along this line, in that it employs a low frequency and low voltage as distinguished from the high frequency and high voltage of the wireless inventions of Marconi, Poulsen, Fessenden and de Forest. This wireless 'phone uses fifty volts whereas the other existing wireless telephones require from 25,000 to 100,000 volts. No arc or spark are used in the Hanson system, and the waves of this system are not affected by static its inventor claims.

Often high voltage and high frequency systems are rendered ineffective by electrical storms. This is caused by the electricity or waves in these storms being of the same character as that of the high voltage systems. As the low frequency waves are entirely different from those of the high frequency they are not affected by atmospheric conditions.

INSTITUTE OF RADIO ENGINEERS FEBRUARY MEETING.

The Institute of Radio Engineers held their monthly meeting on Wednesday evening, February seventh, at the Engineering Societies Building, New York City.

A paper on "The Influence of Commercial Conditions on Transmitter Construction" was presented by Mr. Julian Barth. Mr. Barth described four interesting types of radio transmitters, including cargo ship sets, special land station sets and moderate high power land station sets. The paper was well received by an enthusiastic audience.

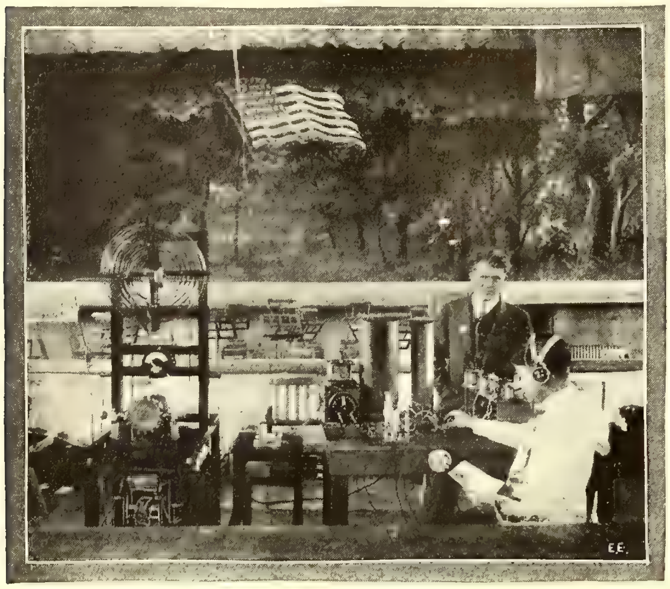
ELECTRIC POWER CO. USES RADIO.

The Arkansas Light and Power Company, of Arkadelphia, Okla., has installed a wireless station at its headquarters. The aerial extends from the top of the local hotel to the top of a bank, a distance of 300 feet. The wires are 100 feet above ground. Application may be made for a government license to operate transmitting apparatus. Messages have been received from more than 1,000 miles away and watches were set by time given from the Arlington station, Virginia.

The Western Union Telegraph Company has announced that all wireless messages to be sent by the way of the Tuckerton station would be refused. Only official government and embassy messages will be received.

RADIO EXHIBIT AT THE KANSAS ELECTRICAL SHOW.

ONE of the most successful radio exhibits of the mid-West was made at Wichita, Kansas, during the Electrical Show. This exhibit was in charge of Mr. Don I. Shepherd, manager, and



A Corner in Radio Display at Kansas Electrical Show, Wichita, Kansas, Showing the Sending and Receiving Set. Mr. Don I. Shepherd, Manager of the Cos-Radio Company and Mr. Geo. Marshall, First Grade Operator.

Charles A. Stanley, engineer, of a local radio company.

A complete sending and receiving station was in operation, including a Thordarson, 1 k.w. transformer, the remainder of the sending set being of Cos-Radio make. The receiving set was arranged for both damped and undamped wave reception.

The public were permitted to listen to both spark and arc stations, the signals being amplified by means of a Multi-audiphone amplifier and horn.

The following messages were received by the Wichita station and read to the public:

New York, December 6th.

Greetings to the Kansas Electrical Show. Let there be co-operation between the electrical people and continuation of our country's electrification until electricity is the universal and only power.

(*Signed*) *Chas. P. Steinmetz.*

New York City, December 7th.

Western Electrical Show. We are all fortunate in being in the business of bringing about the further application of electricity, for even tho we may be reaping a personal profit it is small compared with the benefits realized by further and further uses of electricity and so we may freely feel that we are benefactors of mankind.

(*Signed*) *Henry L. Doherty.*

These messages were relayed to Wichita by the Illinois Watch Co. (9ZS).

One interesting feature of the exhibit was the display of amateur apparatus, a prize having been offered for the best single piece of apparatus and a second prize for the best complete set. Mr. Elmer Showalter of Moundridge received the prize of a loose coupler and C. B. Callinder of Wichita received the prize for the best sending and receiving set.

The purpose of the radio exhibit was to show to the public the various apparatus used in radio work and to increase interest in wireless among amateurs.

SEALS ALL AMATEUR STATIONS ALONG GULF COAST.

The customs collector of the Sabine district has sealed all of the amateur wireless stations in this district and they will remain sealed indefinitely. The wireless stations of the refineries which are used to communicate with their ships at sea will not be closed.

An investigation by Chief Hansen, local navy recruiting officer, revealed the fact that there are twenty-one stations in this district capable of receiving wireless messages, and all of these except a few being capable of also sending messages.

The closing of the amateur receiving stations will prevent the movement of war vessels becoming known generally. The activities of foreigners have made necessary these measures on the part of the Government officials.

AN EFFICIENT BATTERY-TYPE RADIO TRANSMITTER.

The yachtsman of to-day need not limit the extent of his voyage no matter what size boat he possesses, for Mr. A. B. Cole, a radio engineer of New York, has solved the problem of supplying small sailing and motor driven vessels with a thoroly efficient radio transmitter and receiver which can be operated from a storage or dry battery.

Heretofore, difficulties were encountered by small sailing boats in communicating with coast stations or vessels of larger size which are usually fitted with expensive radio outfits, for the reason that it was impossible to obtain a suitable transmitter for the necessary communication purposes.

Several battery-operated transmitters have been previously designed but they proved a failure an account of the inefficient and irregular results which they gave. However, all of these defects have now been entirely eliminated in Mr. Cole's radio-transmitter which embodies several improvements to facilitate the simplest operation of this outfit, which, by the way, is portable.

The accompanying photograph shows the complete equipment. The transmitter consists essentially of a special spark coil operated set. The coil is of special design and will give a high output with a very small input, and the vibrator is so made that it will emit a pure musical note. In its final adjustment the transmitter gives a tone corresponding to the frequency of 250 cycles. The coil is mounted on a Bakelite panel with the additional instruments shown. In this outfit, the oscillating circuit is the same as in standard radio transmitters, inasmuch as a spark gap, condenser and inductance are employed. The discharge takes place in a quenched gap which may be seen at the center of the panel. It consists of two heavy metal plates accurately machined and supported on two standards. A large sparking surface is used in this gap, which was found to give the best results.

A high tension condenser is employed, and this is placed behind the panel. The aerial tuning inductance is also mounted on the rear. Various steps on the inductance are obtained by means of five jacks, which are connected to the different sections of the helix. Different taps are connected by means of a plug connected to one lead from the quenched spark gap, as noted in the photograph. A hot wire ammeter is included for indicating the amount of current flowing into the antenna; this is located on top of the panel. The binding posts of this meter are used to connect the transmitter with the aerial. A switch for changing from receiving to sending or vice-versa is shown on the left center of the panel. It is of the single rotary blade type, operated by an insulating knob. The lower switch is used for connecting the power supply with the instruments. The two binding posts to the left are for power supply, while those to the right are for connecting the key. Ground connection is obtained thru the lower left center binding post.

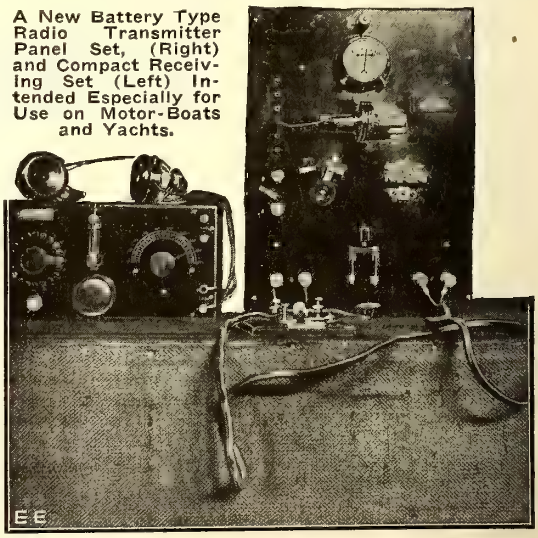
The receiving set is of a cabinet type, seen on the left. This consists of a loosely coupled tuner, the primary of which is regulated only, while the coupling is controlled by means of a slide rod not shown. A variable condenser is also used, the adjusting knob and scale of which may be seen on the right of the outfit. The crystal type detector and buzzer adjustment, here used, are mounted on the front panel of the cabinet. Standard high resistance radio telephone receivers are employed.

A series of experiments were conducted with this outfit and it proved to be very efficient, it having been found possible to transmit thirty miles with an input of only twenty-four watts on a 12-volt battery, and employing an antenna having a natural period of 200 meters. The tone emitted by the transmitter corresponds to a frequency of 250 cycles and its wave has a decrement of .2 which is the value permitted by the United States Government.

The extreme lightness and compactness of this outfit makes it invaluable as a portable military set. With its use, there is eliminated the cumbersome generator and the two men needed for driving the same. Only three men will be needed to carry the complete equipment; one for the outfit, the second carrying the battery while the third handles the antenna system.

It can be used with great success in conjunction with military ambulance work which necessitates some means of communication at all times, and there is no doubt in our minds, that it will be utilized

A New Battery Type Radio Transmitter Panel Set, (Right) and Compact Receiving Set (Left) Intended Especially for Use on Motor-Boats and Yachts.



for this purpose in the future.

Besides being extremely compact the set designed by Mr. Cole possesses the merit of distinct simplicity, both in transmitting and receiving.

The Early Days of Radio in America

By DONALD McNICOL, Mem. I. R. E.
Assistant Electrical Engineer, Postal Telegraph-Cable Company

VERY few of our younger radio readers can recall the important events of the early days of radio in the United States most probably. We feel certain that you will be greatly interested in this timely contribution to radio history by Mr. Donald McNicol, who was actively interested in the early-day developments of Marconi, Lodge, Fessenden, de Forest, Stone, and other leading lights in this now distinct branch of applied science. Do you know when the first wireless text-book appeared in this country? When the first U. S. Navy instruction book was publisht? Who sold the first "coherer" sets for experimenters?—Then read Mr. McNicol's article.

THE history of an art or a science, like that of individuals, is not of much general interest until the subject has attained permanent prominence. The historical development of a particular branch of science, such as radio telegraphy, in order to be complete and of instructive value should, if possible, be traced thru the personal connection therewith of all of its pioneers.

So called official records alone are not sufficiently comprehensive. Many of the most illuminating essentials of historical narrative escape the observation of the official compiler and, in so far as radio is concerned, I believe it to be the duty of those acquainted with views and facts of its introduction to set these down for the inspection of the ultimate historian. To the extent this is done will be lessened the possibility that some item of value may be lost to the written records.

In February, 1896, Guglielmo Marconi journeyed from Italy to England for the purpose of showing the British telegraph authorities what he had developed in the way of *operative* wireless telegraph apparatus. His first British patent application was filed on June second of that year.

Thru the cooperation of Mr. W. H. Preece, chief electrical engineer of the British Post-office Telegraphs, signals were sent in July, 1896, over a distance of one and three-fourths miles on Salisbury Plain.

In March, 1897, a distance of four miles on Salisbury Plain was covered. On May thirteenth of that year communication was establisht between Lavernock Point and Brean Down, a distance of eight miles. During this latter demonstration Prof. Slaby, of Germany, was present as a spectator.*

In America, (1890-1896), many students of science were in touch with the discoveries made in Europe during this period; but it was not until 1897 that the utilitarian American mind sensed the commercial possibilities of the advances being made abroad.

In its March, 1897, issue *McClure's Magazine* presented a long illustrated article entitled "Telegraphing Without Wires," by H. J. W. Dam, describing the experiments of Hertz, Dr. Chunder Bose, and the youthful Marconi.

Telegraph Age, New York, in its issues of November 1 and November 15, 1897, reprinted a long article from the London *Electrician*, entitled "Marconi Telegraphy." This article consisted chiefly of the technical description which accompanied Marconi's British patent specification number 12,039 of 1896.

In October, 1897, *Scientific American* published an instructive editorial dealing with the status of Wireless Telegraphy. The article discust Nikola Tesla's work, his claims and his prophecies, also the reports of Marconi's experiments with induction coils and coherers.

*Dealing only with the *Art* of wireless telegraphy we can reasonably omit reference to the work of Joseph Henry, in America; Hertz' work; the development of coherers; and Sir Oliver Lodge's famous lecture of 1894.

The *Journal of the Franklin Institute*, in December, 1897, covered practically the same ground.

In the year 1898, Mr. William Maver, of New York, read a paper on wireless telegraphy at the annual convention of the Association of Telegraph Superintendents, at Wilmington, N.C. The information communicated was in the main a review of Dr. Marconi's early work.

In the June, 1899, issue of *McClure's Magazine* there appeared a long illustrated article by Cleveland Moffatt, entitled "Marconi's Wireless Telegraphy." In this article the cross channel tests were described in a popular, semi-technical manner.

American technical magazines at first were somewhat slow in grasping the significance of the work being done in Europe; their references to the subject consisting mainly of brief reviews of articles appearing in foreign periodicals, with the result that American telegraphers of an experimental bent were supplied with but meager information, and that not of much practical value.

In its February 16, 1899, issue *Telegraph Age*, New York, printed an elementary article by Willis H. Jones, which was the first really lucid description of the system served to American telegraphers.

In July, 1899, the *American Electrician* published a complete semi-technical description of Prof. Jerome J. Green's demonstrations of wireless telegraphy at Notre Dame University, Montreal, Canada. This article was hailed as a great find by amateurs, and in various parts of the country demonstration sets were made up, operated and exhibited.

In September, 1899, during the International Yacht Races off New York harbor, the steamer *Ponce* was equipt with radio apparatus by Marconi, for the purpose of transmitting reports of the progress of the race. Two receiving stations were equipt; one on the Commercial Cable Company's cable ship *Mackay Bennett*, stationed near Sandy Hook, and connected with a land line station on shore by means of a regulation cable; the other at Navasink Highlands. This demonstration, altho not highly successful, immediately brought the subject to the fore in this country.

In 1900, the erection of the first Marconi station at Cape Cod, Mass., was begun.

In the fall of 1900, the author of this paper constructed the first amateur wireless set used in the twin cities, Minneapolis and St. Paul, Minn. Later he exhibited the first sets shown in the cities of Butte, Mont., and Salt Lake City, Utah. In later years thriving radio clubs have grown up in these various centers.

In 1900, Mr. Thomas E. Clark, of Detroit, Mich., began the manufacture of radio apparatus. Handsome catalogs were issued illustrating *coherer* and *register* sets. One of Mr. Clark's assistants was Mr. J. Z. Hayes, chief operator of the Postal Telegraph Company, Detroit.

In March, 1901, the Marconi Company installed apparatus at five stations on as many islands of the Hawaiian group. For a long time these installations were of little value due to a scarcity of competent operatives.

During this year the Canadian government installed two stations in the Strait of Belle Isle; the New York *Herald* stations at Nantucket, Mass., and Nantucket light ship.

The crowning radio event of the year was the reception by Dr. Marconi at St. Johns, Newfoundland, of the now famous letter "S," transmitted as a test signal from his English station; this was on December 11, 1901.

The most important published article on radio during 1901 was that of Reginald A. Fessenden, which appeared in the *Electrical World* of June twenty-ninth. Prof. Fessenden was at that time connected with the United States weather bureau, and his communication described the work accomplished by him under the direction of Prof. Moore, beginning in January, 1900. The article contains an interesting exposition of *Syntony* as at that time understood.

In its February 9, 1901 issue, *Collier's Weekly* contained a long illustrated article by Dr. Nikola Tesla, entitled "Talking With the Planets." The *Scientific American* of March ninth published a complete account of the so-called Slaby-Arco system of wireless telegraphy, and the same magazine in its December twenty-eighth issue, gave further details and illustrations of Slaby-Arco equipment. These articles were written by A. Frederick Collins.

In 1902, the Canadian Marconi Company was formed, as well as the American Marconi Company.

On January thirteenth, Dr. Marconi delivered a lecture to the members of the American Institute of Electrical Engineers at New York, describing his system, and gave an account of the progress made up to that time.

J. H. Bunnell & Company's catalog of 1902 lists a page of wireless goods. A relay, coherer, and tapper receiving outfit was listed at $25.00.

On September first Prof. Fessenden's contract with the U. S. Government expired. He then established headquarters in Pittsburgh, Pa., and began a series of careful investigations which led to important results.

In 1902, the United States Signal Corps established stations at Sandy Hook, N.J., and at Fort Wadsworth—twenty-two miles apart. The operators in charge were Messrs. L. E. Harper and C. J. Applegate. The instruments at first employed were manufactured under the direction of Dr. Lee de Forest, who had been developing new ideas during the two years previous. The detector consisted of *two aluminum rods with a steel needle laid across them,*

(Continued on page 911)

The Calculation and Measurement of Inductance

By H. WINFIELD SECOR and SAMUEL COHEN

Part II

IN the last installment we considered the calculation of inductance while in this issue we shall confine ourselves to the measurement of inductance.

There are several methods which have been adopted for the measurement of this important quantity and the most practical and simple ones will be discust here.

The inductance of a coil which is connected in a low frequency circuit can be determined by connecting it as indicated in Fig. 1. A is the source of alternating current the frequency of which is known, R a variable resistance or variable impedance coil for controlling the current, Am and Vm are A.C. ammeter and voltmeter while L is the coil, the inductance of which is to be measured. The connections of the various instruments should be properly made. In the act of measuring, care should be taken to see that the meters indicate maximum deflection before opening the circuit.

The observed indications of the meters are then substituted in the following equation:

$$L = \frac{1}{\omega}\sqrt{\frac{E^2 - I^2R^2}{I^2}}$$

Where

L=Inductance of the coil in henries

E=Indicated voltage

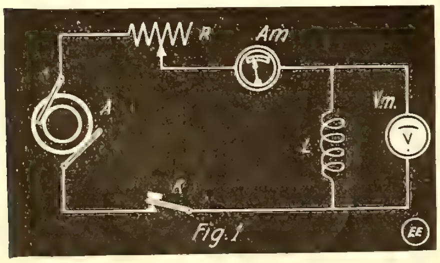
I=Indicated amperage

R=Resistance of the coil in ohms; this value can be obtained by measuring it with a Wheatstone bridge.

ω=Angular velocity which is equal to (3.1416x2) × the frequency. If an alternating current generator is used the frequency would be $N = \frac{NS}{120}$

N being the number of poles of the alternator and S the number of revolutions per minute.

The above method is applicable in measuring the inductance of coils up to .02 henries, when employing frequency of 25 to 60 cycles, if a higher frequency is used such as 500 cycles, the scheme can be used to advantage to measure the inductance as high as .004 henries. The latter coils, however, are those which are of the air core type, while those of the former are of the magnetic core type, such as employed in impedance reactance coils.



Simple Method of Measuring and Computing Inductance of a Coil by Connecting It to An Alternating Current Circuit with a Volt and Ammeter.

The inductance of magnetic core coils is sometimes very important, especially when it is desired to determine the total impedance of the primary side of a transformer which is connected in series with a variable resistance. The expression for such a circuit is:

$$Z = \sqrt{R^2 + \omega^2 L^2}$$

Where:

Z=total impedance

Photo Showing Several Types of Radio Inductances and Wave Meter as Used for Measuring the Value of the Inductance of Such Coils.

R=the resistance of the total electrical circuit (primary)

ω=angular velocity (2πN)

N=frequency in cycles per second

L=inductance.

We shall next consider the measurement of inductance by a Wheatstone bridge, which is usually in the experimenter's laboratory and if he does not possess one, we refer him to the September, 1916, issue of this journal. The schematic connections of the Wheatstone bridge as used in this measurement is shown in Fig. 2, while Fig. 3 shows the connections of a slide wire bridge.

Referring to Fig. 2, the resistance arm D should be a plug resistance, having a range from 0 to 20,000 ohms and the condenser C should be of the variable air-dielectric type, while the series variable resistance P should be about 4,000 ohms for its maximum. The coil the inductance of which is to be determined is placed across the terminals marked XX of the bridge. The resistance of the coil is to be known, and this is obtained by measuring it on the same or a different bridge. Across the arms of the bridge is shunted a high frequency buzzer in series with several batteries and key K, while across the neutral point, the resistance P and galvanometer G, telephone receiver T and key K¹ are connected as indicated. Where the bridge arms or inductance have a high resistance, it is necessary to employ a buzzer inductively connected thru a telephone or medical induction coil as indicated by the dotted lines in Fig. 2.

The first object in the procedure is to obtain a steady balance on the bridge. The resistance P and condenser C being removed, the resistance arms ABD are varied until a minimum sound is heard in the receiver T, while the bridge is being excited by the interrupted current of the buzzer. As soon as this balance is obtained, the resistance P and capacity C are reinserted. It will be found that when the galvanometer key is first closed and then the battery key, the galvanometer coil is found to be in motion, thus indicating that the balance is not precise, but this may be annulled by varying P and C until the kick of the galvanometer is entirely eliminated. A still finer balance can be obtained by using the (75 ohm) telephone receiver instead of the galvanometer. It should be remembered that when using the galvanometer for the indicating device that more battery should be employed as the time-constant of the galvanometer is slow, compared with that of the vibration of the buzzer.

Having observed the values of the arms of the bridge, capacity of condenser and resistance of P, they are then substituted in the following equation, which is a relation of inductance of the coil to that of the other factors, thus we have:

L=C [P(R+D)+AR]

L=Inductance of coil in microhenry

C=Capacity of condenser in microfarads when point of balance is obtained

P=Resistance in ohms

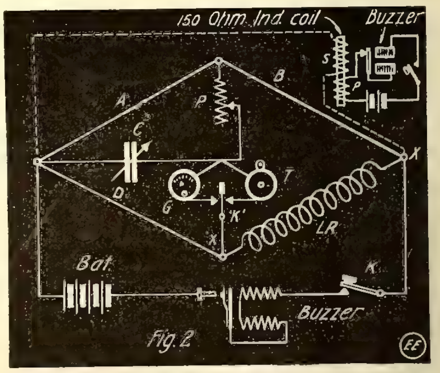
R=Resistance of coil, the inductance of which is to be determined.

AD=Resistance of arms of bridge.

[*When it is desired to have the unit of measurement in millihenrys, it is necessary to divide the result obtained by 1,000 or by 1,000,000 to reduce it to henrys.*]

The same procedure should be followed when using the slide wire type of bridge, the only change in operation being to move the slider S along the wire until resonance is obtained (see Fig. 3). The known resistance D should be of the non-inductive box type and should have a capacity of 40,000 ohms, varying at intervals of 100 to 200 ohms per plug.

Another method of measuring inductance is by means of the Siemens and Halske inductance bridge.* A wiring diagram of this type of instrument is shown in Fig. 4. It consists of a standard slide wire bridge shunted by a buzzer, transformer (see Fig. 2, also) and battery. The arms of the bridge are linked with the unknown inductance Lx, which is connected in series with a small variable resistance R. An additional variable resistance S is connected as shown and usually consists of a plug resistance box. This resistance ranges from

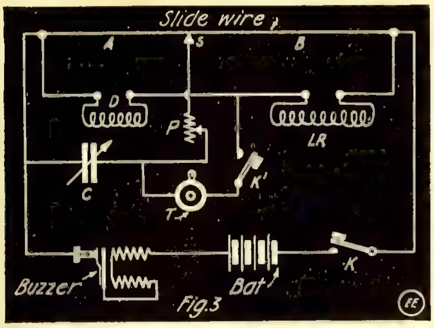


Wheatstone Bridge Arranged with Buzzer Excitation for the Measurement of Inductance by the Fleming-Anderson Method.

one-tenth to five-tenths of an ohm. The standard inductance I is of special con-

*See article by Dr. A. N. Goldsmith in *Wireless Age* for April, 1914.

struction, it consists of a small coil into the center of which an iron core C of suitable shape is placed. The core is



Utilizing a Slide-Wire Bridge for the Measurement of Inductance. Principle Followed in the "Sage Ohmmeter" for Measuring Inductance by Comparison.

placed on a movable rack so as to permit the core to be moved in or out of the coil at will. Thus by allowing the core to be wholly in the coil the inductance will be maximum; in this manner the inductance of the coil is made variable by means of this ingenious variable core arrangement. The iron of the core C is made from a number of iron wires finely divided and imbedded in paraffin wax. In this way the core is made to have very small alternating field losses, such as hysteresis and eddy currents. The alternating current for the bridge is derived from a buzzer linked across the bridge as indicated. The indicating device consists of a telephone receiver.

The general procedure in measuring inductance with this type of bridge is as follows: The alternating current source is connected so as to excite the circuit and then closing the telephone receiver switch K^1, the slider U is adjusted to obtain as nearly a minimum sound in the receiver as possible. In order to further reduce the intensity of the sound the resistance R and S are adjusted, also the core C of the standard inductance coil I. When the position of resonance is obtained, the inductance of the unknown coil Lx is derived by substituting the observed values in the following expression:

$$Lx = \frac{a}{b} I$$

Where
Lx=Inductance of the unknown coil
a=Length of one side of wire
b=Other length of wire
I=Inductance of the known coil.

It should be remembered that in using the known inductance that it is necessary at first to standardize this coil with respect to every position of the iron core within the coil, before it is possible to use it as a standard. In actual practise this coil is supplied with a calibration curve showing the value of the inductance with every position of the core. The measurement of inductance with this method is accurate within one-half of one per cent.

Having described the general method of measuring inductance by means of the various methods of the employment of the Wheatstone bridge, we will now discuss another well-known method of performing this measurement. This is dependent upon the resonance of two coupled circuits. In utilizing this scheme there are required two standard calibrated variable condensers, one standard inductance, an exciting apparatus such as a buzzer, and a receptor consisting of a crystal detector and telephones and connected as shown in Fig. 5. The procedure with this arrangement is this: the circuit L_2C_2 is excited by means of the buzzer and the coupled circuit L_1C_1 is tuned to resonance by noting the maximum sound in the receptor circuit. In this connection the switch is so placed that inductance L_1 only is in the circuit. The position of resonance of the condenser scale is noted and marked as Ca. The switch is then changed so as to connect the unknown inductance X in the circuit and the resonance position is again obtained and call this position on the condenser scale as Cb. Since resonance existed in the coupled circuit, their relation can be exprest as

$$C_a L_2 = L_1 C_1$$

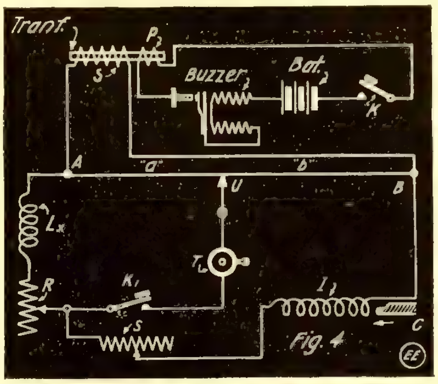
which is the expression for the first position of resonance, but as soon as the unknown coil was added then we have

$$(L_1 + X) C_1 = L_2 C_b$$

Solving for the unknown inductance X we have

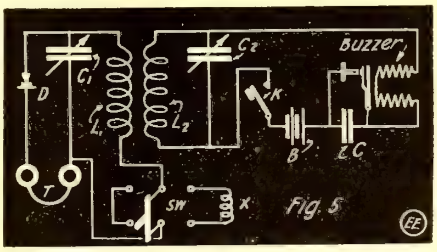
$$X = \frac{L_2 (C_b - C_a)}{C_1}$$

which gives the value of the unknown inductance in terms of the capacity of one of the condensers and the standard inductance. It is advisable when using a buzzer exciter that it should be of such construction as to produce a fairly high note.



Arrangement of Siemens-Halske Inductance Bridge Having a Calibrated Coil Provided with an Adjustable Iron Core. Excitation by Induction Coil and Buzzer.

It sometimes happens that the inductance of an antenna is required and for this determination the following data will be necessary:



How the Wave Meter, with Known Inductance L_1, Is Employed to Measure Value of Coil L_2. Buzzer Excitation Is Employed.

Inasmuch as inductance is a factor of wave-length of the antenna system and since it possesses capacity with respect to the earth, it seems therefore possible to determine one of these units if the other is at hand. The well-known formulae for expressing the capacity of an aerial in terms of its wave length and inductance is herewith given:

$$C = \frac{\lambda^2}{36\pi^2 10^{16} L}$$

Where:
C=Capacity of the antenna system in farads
L=Inductance in henrys
λ=Wave lengths in meters.

Or, solving L in terms of its capacity and wave length, we get

$$L = \frac{\lambda^2}{36\pi^2 10^{16} C}$$

The connections for this measurement are indicated in Fig. 6. The antenna is excited by means of a buzzer which is shunted with a condenser C. This is used for charging and discharging the antenna. La and Lb are two known inductance coils which are inserted at different times, L is a coupling coil which consists of one or two turns of wire. This coil is placed in proximity to the coil which constitutes the inductance of a wave meter, coupled with a variable condenser C_1 and a responsive device D and T, which are a crystal detector and telephone.

In the actual measurement the antenna system is excited by starting the buzzer, and the natural wave length noted. Then the additional inductances La and Lb are added and the corresponding wave lengths are obtained. The coupling between the coils should be kept as loose as possible in order to obtain a more accurate resonance position. Having obtained the two corresponding wave lengths and knowing the values of the two standard inductances La and Lb, we can then readily obtain the inductance of the antenna system by substituting the values in the following equation:

$$Lz = \frac{\lambda^2 (L_b - L_a)}{(\lambda_b^2 - \lambda_a^2)}$$

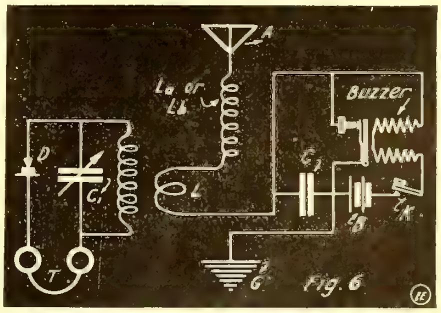
Where:
Lx=Inductance of the antenna
$\lambda 2$ =Natural wave length of the antenna
La=Inductance of one standard
Lb=Inductance of second standard
λa =Wave length when coil La is in circuit
λb =Wave length when coil Lb is in circuit.

The method just outlined for the measurement of the aerial inductance is not very accurate on account of the varying distribution of potential and current along the antenna at the different wave lengths used. It is very difficult to overcome these defects in this kind of work; in fact, it is the most difficult quantity to measure accurately in radio work. The measurement of inductance is very important in all radio work and the novice should not lose sight of its importance.

NEW HAVEN Y.M.C.A. RADIO CLUB ACTIVE.

Members of the New Haven, Conn., radio club recently erected a two strand aerial for their wireless station, 450 feet long, reaching from the Hotel Taft to the Y.M.C.A. building. It is believed that with this equipment messages from Germany may be heard.

Six members have successfully applied for licenses as wireless operators and there is a total membership of twenty-five. No sending set has been put up in the rooms of the local club, but it is probable that one will be installed in the near future.



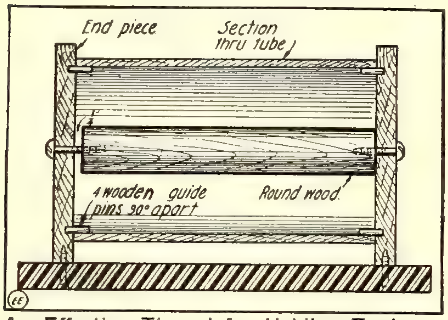
Utilizing the Wave Meter to Ascertain the Inductance of a Radio Antenna. The "Exciting" Inductance Consists of a Turn or Two of Wire "L," Which Is Connected in the Aerial Lead as Shown. A Buzzer and Condenser "C" Serve to Excite the Aerial Circuit.

SUBSTANTIAL TIE-ROD FOR TUNING COILS.

The illustration shows a good method of making a tie-rod for tuning coils. All that is needed is a piece of broom-handle and two stout wood screws. The rod should be cut about ¼" shorter than the tube, as shown at A. The end at B. should be screwed up tight first. Then the tube is slipped over and the other end screwed up. Four wooden guide pins should be doweled in each end frame to keep the tube in the proper position.

The coil I have, made in this way, is very satisfactory.

Contributed by
WILLARD HUNGERFORD.

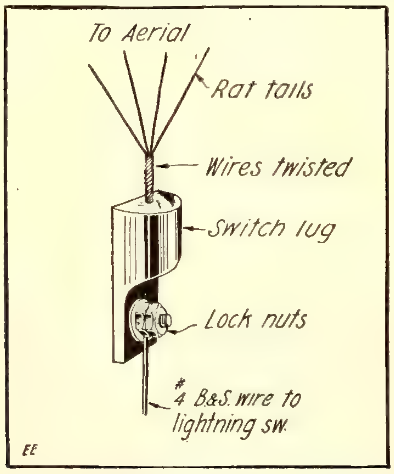


An Effective Tie-rod for Holding Tuning or Loading Coil Frames Together With. The Tie-rod Is Cut a Little Shorter Than the Distance Between the Coil Ends.

FIRST-CLASS RAT-TAIL CONNECTOR.

As shown in the drawing, this connector consists simply of a switch-lug, the four (or any number) of wires from the aerial being soldered to the lug, and the single No. 4 lead-in wire fastened by means of a machine screw. The whole joint is then taped up with rubber (gum) tape to prevent corrosion.

In soldering, a few words as to how to do it correctly will not be amiss. The wires from the aerial are twisted together for an inch or so, at one end. This end is then scraped thoroly, and a little soldering paste is rubbed on it. Now clean out the inside of the lug and put a little paste in it also. The lug is then held in the flame of a Bunsen burner or blow-torch. It should be filled up with small pieces of



For High Efficiency the Rat-tail Leads from an Aerial Should Be Soldered to the Lead-in Wire. A Switch Lug Makes a Good Joint.

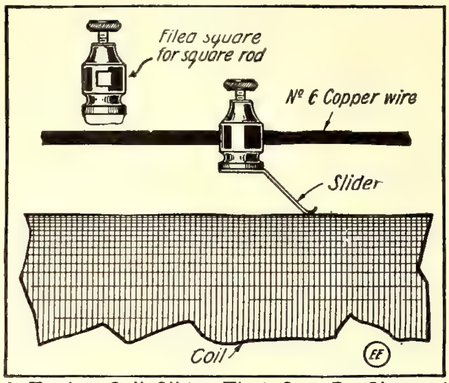
solder before placing it in the flame. When the solder has melted the twisted wires are pushed in and water thrown on the lug to cool it off quickly. The result is a perfect joint. The heavy lead-in wire from the lug is fastened with a brass machine-screw, inserted in the hole in the lug.

This is a sure connector, and for cheapness and neatness can't be beat.

Contributed by FRANK TALONE.

TUNING COIL SLIDER MADE FROM BINDING POST.

First obtain a piece of No. 6 B. & S. gage copper wire and cut it to the size desired. A binding post and a thin piece of



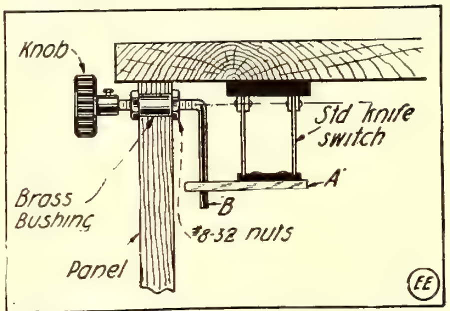
A Tuning Coil Slider That Can Be Clamped in any Position—Made from a Binding Post.

brass are then procured, bending the brass to the shape shown in the illustration and soldering it to the base of the binding post. The rod is slipt thru the binding post and the end fastened to the coil heads. Those having square rods may use this stunt by filing out the hole in the post until it is square.

Contributed by JASPER TELFORD.

USING KNIFE SWITCHES IN RADIO CABINET SETS.

This is a good way to mount a change-over switch or any kind of a switch in a



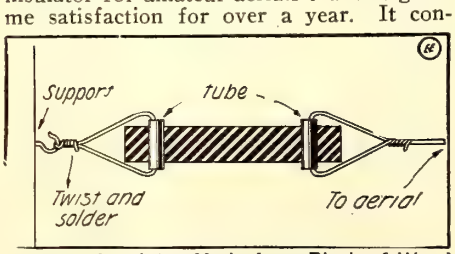
Novel Way of Mounting a Knife Switch so as to Be Controlled by a Rotary Knob on a Cabinet Set.

cabinet set where the porcelain would not look well. Screw the switch on the under side of the top of your cabinet. Take off the handle and screw on a piece of hard wood or fiber A, allowing one end to project a little way. Bore a hole in this end. Then drill a hole in the front of the cabinet exactly in line with the blade pivot screws. Put a rod, B, thru this, bent as shown. One end goes thru the hole in the piece of hard wood or fiber. A switch knob is put on the other end.

Contributed by
GEORGE NICHOLS, JR.

SIMPLE AERIAL INSULATOR.

The accompanying sketch is that of an insulator for amateur aerials that has given me satisfaction for over a year. It con-



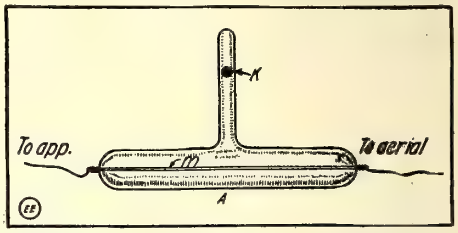
Antenna Insulator Made from Block of Wood Thru Which Two Porcelain Tubes Pass.

sists of a block of wood "A," drilled to fit a porcelain tube "B," such as those used in wiring houses. The tube is broken in the center and one piece is inserted in each hole. The wire to the support is fastened thru one tube and the aerial thru the other. Porcelain tubes may be snapt off by striking them sharply against a brick or other sharp-cornered body. A good method is to grind a groove around the point of desired rupture by means of a high speed emery wheel. The tube can usually be then snapt in half by a sudden blow as above described.

Contributed by NAT SHEPARD.

A PRACTICAL RADIATION METER.

When installing and testing a transmitting helix and an adjustable condenser, a radiation meter is a necessity. This simple piece of apparatus consists of a glass tube, A, about five inches long, with a fine plati-



Simple Hot-wire Ammeter in Which the Heat Causes a Drop of Alcohol "K," to Rise Within the Capillary Tube.

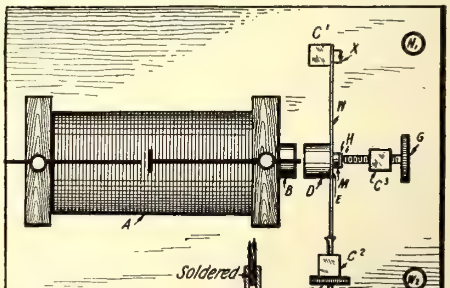
num wire, M, extending its entire length. A small bore capillary tube, K, which contains a drop of alcohol, is blown in on one side. This tester is connected between the antenna and the transmitting instruments. When the current passes through the platinum wire it heats and expands, slightly compressing the air, forcing the drop of alcohol upward. By changing the number of condenser plates, and the turns of the helix until the drop is at its most distant point, the greatest radiation and best adjustment are made known.

Contributed by OTTO WHITELOCK.

HIGH FREQUENCY VIBRATOR FOR INDUCTION COILS.

The vibrator shown in the accompanying sketch can be easily constructed and attached to any coil. It is suitable for small spark or medical coils, and greatly improves the note of the spark when used for wireless.

In Fig. 1, A is the body of the spark coil, B is the core, C_1 and C_2 are two square



A High Speed of Interruption May Be Attained With This Break as Both Ends of the Spring Are Fastened.

brass standards, W is a thin strip of spring brass or phosphor bronze attached to the standard C_1 by the screw X; to its opposite end is soldered the tension srew, F.

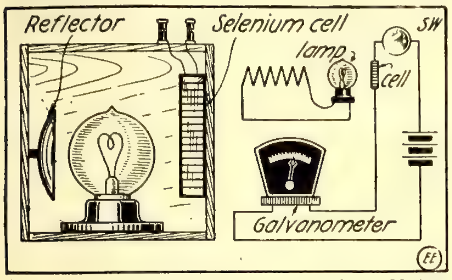
At the center of the strip W and opposite the core B, a short piece of soft iron rod D is attached by the screw M, and to the head of this screw is soldered a small piece of platinum or silver H.

C_3 is the standard supporting the contact screw G—the old one from the coil may be utilized or a new one constructed. N_1 and W_2 are the terminals.

Contributed by R. L. DUDGEON.

A SELENIUM CELL RADIATION AMMETER.

The illustration indicates a radiation meter that can be used on radio transmitting sets, ranging from a one inch coil to a one kilowatt transformer. Usually only an expensive meter will register on a one inch coil. This scheme comprises a pilot lamp placed in a darkened box, together with a selenium cell as shown in the illustration. The coil of wire is placed near the oscillation transformer. When the transformer is operated the pilot lamp lights up and lowers the resistance of the selenium cell, allowing some of the bat-



In This Selenium Cell Radiation Meter, Varying Intensities of Light Are Caused to Affect the Resistance of the Selenium-Galvanometer Circuit.

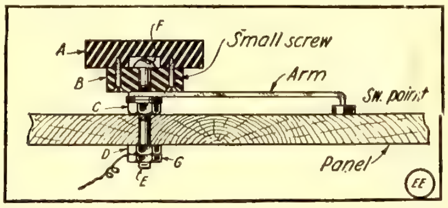
tery current to pass thru. This registers on the galvanometer. The pilot lamp may be put in series with the aerial. The brighter the lamp glows, the higher the deflection on the galvanometer.

Contributed by FRANK WALCUTT.

A NOVEL "TAP" SWITCH OF NEAT APPEARANCE.

The stumbling block for many amateurs when constructing a Navy type coupler or a cabinet tuner is the *tap switch*. Following is a description of a novel tap switch with which the writer has had excellent results.

The knob is made of two pieces of hard rubber, 3/8 inch thick, as shown at A and B. A hole 1/32 inch larger than the diameter of the machine screw E, is drilled thru the latter and a 1/4 inch hole, 1/4 inch deep, is drilled in A from the under side, to accommodate F. The screw E is now in-



Efficient Tap Switch Construction Giving Thoro Insulation at the Knob.

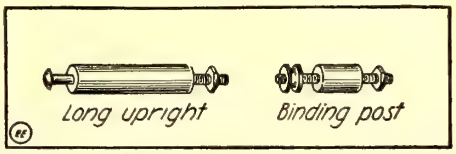
serted in the hole drilled thru B. The latter is fastened to A by means of two, or better three, small wood screws which also hold the blade as shown. E is secured to the panel by means of the lock nuts C and D, which hold it firmly. Another nut G, can be used to hold the connecting wire if solder is not desirable. The great advantage of this type of tap switch over the ordinary kind is that the shaft is stationary and the knob only rotates; therefore the machine screw can be permanently fastened to the panel. This eliminates the experimenter's greatest bug-a-boo in rotary switch construction—loose switch leads.

Contributed by I. J. AMARDIEL, JR.

[*Large switches of this type may be improved by placing a small spiral spring under the head of the machine screw with suitable washers, etc., to press the blade and knob against the washer C.*—ED.]

GOOD BYE TO FATHER'S "JIMMY" PIPE!

Here at last we have a use for stems of



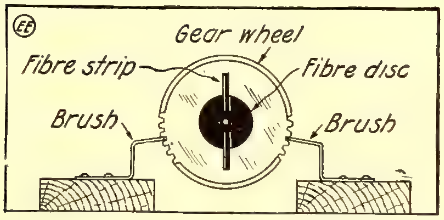
Even the Pipe-Stem Has Succumbed to the Radio Amateur—What Next?

old "jimmy" pipes that have seen better days. First cut off the mouthpiece from the stem and pass a machine screw thru it. This makes a serviceable upright. Shorter binding posts can be made by cutting off sections of the stems, passing a machine screw thru it and adding two nuts as shown.

Contributed by NATHAN W. WOLPERT.

AN UNDAMPED WAVE TIKKER.

Oftentimes amateurs have trouble in bringing in the high powered undamped wave radio stations. Here is a tikker which I have tried out and found to work very well. At a hardware or sporting goods store you can procure a gear wheel, such as is used in Meccano sets, for about fifteen cents. With a



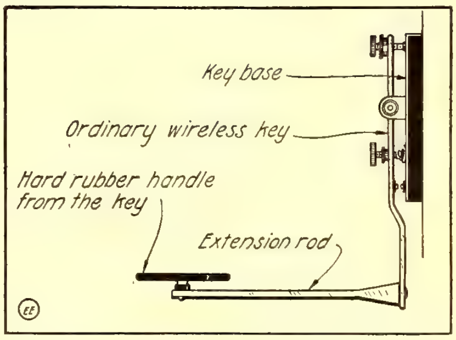
A Tikker for Receiving Undamped Wave Signals, Made from a Small Gear Wheel Mounted on a Battery Motor and Two Brushes.

large drill bore out the center of the wheel and insert a piece of fibre or some good insulating material that will fit tightly. This is then fastened to the wheel by screwing a thin piece of fibre to the insulating material and the wheel on both sides. A hole is drilled in the insulating material to fit the shaft of a small motor. The make and break brushes are made by screwing to the base (or whatever the motor is to be placed upon), two thin pieces of brass. These are then bent so that when the motor is started there will be an intermittent interruption of the current.

Contributed

PANEL WIRELESS KEY.

The illustration shows a wireless key altered so as to be of suitable design for panel radio sets. The only new part is a



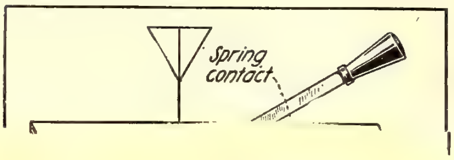
How the Transmitting Key May Be Effectually Mounted in Cabinet Style Radio Sets.

brass or fiber extension rod. This is filed down and threaded at one end to fit into the hole which formerly contained the rubber knob. Then it is up-set (riveted) or secured with a nut to hold it securely. A hole is bored in the other end to hold the key-knob which is held in by the tight fit caused by the threads.

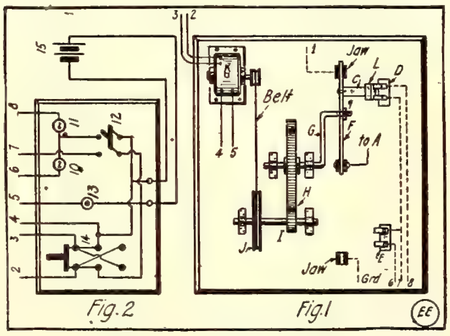
Contributed by H. R. HOSBACH.

A SAFETY IDEA FOR LIGHTING SWITCHES.

Many times it happens that the lightning switch is not thrown to the ground position, endangering the apparatus and building in which they are located. Forgetfulness is the cause of neglect in many cases. This



the field wires of motor leading to reversing switch 14 in Fig. 2. Wires Nos. 4 and 5 are the armature wires leading to the battery 15, with a push button 13, cut in on the wire as per diagram. Wires Nos. 6, 7 and 8 run to red and white lamps which, when not needed for indicating po-



A Remote Control Antenna Switch, Equipt with Tell-tale Lamps and Motor for Throwing the Switch Blade Over.

sition of the switch, are cut off by switch at 12.

OPERATION:—Close switch 12, which in this case lights the white lamp at 11. Throw reversing switch at 14 down and push button 13 until the red light is lighted, then release push button. Open switch at 14 and then 12 and you are ready for the next thunder-storm.

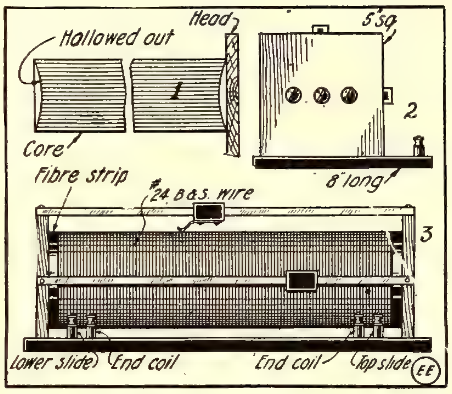
The motor I have in use is a "Standard" four-volt machine, and the lamps are of the six-volt carbon type. The battery consists of four dry cells, or if the house current is at hand a small transformer may be used with a switch in the primary circuit.

Contributed by HERBERT W. FRYER.

TUNING COIL FOR 1,000 METER WAVE LENGTHS.

The following are the details for the construction of a large tuning coil for wave lengths of about 1,000 meters:

Obtain a wooden core, as it is much more solid than the usual cardboard tube. It may be turned from a piece of wood 17 inches long by 5 inches square. Hollow out the ends slightly, as this makes the

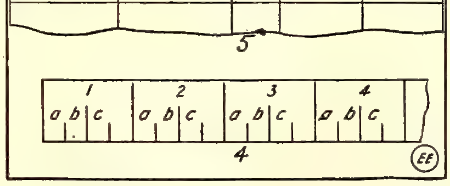


Improved Design of Tuning Coil for 1000 Meters Wave Length.

heads of the coil fit tightly (Fig. 1). The heads may be made 5 inches square (the core is 4 inches in diameter) and all may be set on a base 18 inches long and about 5 inches or more wide.

First bore a hole in the center of the core, in which may be put a finishing nail for a pivot. In this way the winding may be done without the use of a lathe. The coil may be wound by turning the cylinder in the frame with the left hand and guiding the wire on with the right.

Station	Position	Call	Top slide	Lower slide
Mare Island	Vallejo	N.P.H	7-A	9-B
San Francisco	N S E	K.P.H	12-B	9-A
John Supow	Sacramento	W.C.A.	11-A	11-B



Tuning Chart Suitable for Amateur Radio Stations.

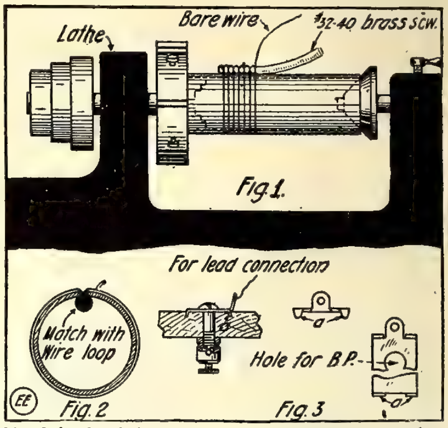
The two slider rods are put on the top and side. On the ends it is a good idea to place fiber strips to hold the wire. This can also be held by brass shoe tacks.

Another detail in connection with this tuner is a wave length or station scale. This is used for keeping a record of the positions of the sliders for the different stations. A section of it is shown at 4. It is divided into inches, half and quarter inches. The quarters are numbered a, b and c, while the inch marks carry numerals, 1, 2, 3, etc. A pointer should be placed on the slider, of course, to co-act with the scale. Thus the station calls may be charted as shown at 5.

Contributed by LE ROY D. BROWN.

TUNING COIL HINTS.

Many amateurs have no doubt found it very hard to wind bare wire tuners or loose couplers. The ratio used by many reputable concerns for loose couplers is 32 wires per inch for the primary and 40



Useful Wrinkles for Those Constructing Tuning Coils and Couplers, Including Metal Lead Terminals.

wires per inch for the secondary. The size of wire used is optional; any catalogue will give you the proper ratio. Thread a brass rod with a 32-thread die. As the 40-thread die is very small it would be well to turn threads on the rod with a lathe. The illustration (Fig. 1) explains how this is worked. Any suitable winding device may be used. A coat of orange shellac will hold the wire in place.

Buzzer. An Adjusting Screw Before the Clapper Does the Trick.

If you are using some new wrinkle or attachment in your station, why not write it up and send it to the editor? All articles accepted and published are paid for at regular rates. Manuscripts should preferably be typewritten. Pencil sketches sufficient.

THE CONSTRUCTOR

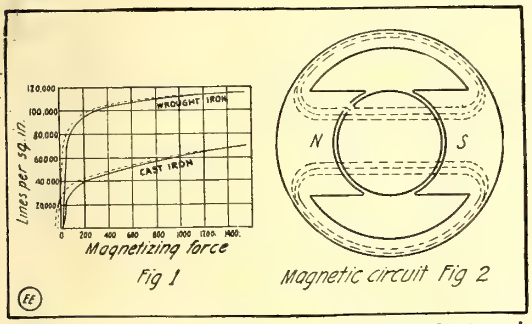
Building a 500-Watt Direct Current Dynamo

This Dynamo Is Suitable for Lighting Lamps, Charging Storage Batteries and Exciting Radio Transmitters

By GEORGE STURLEY

IT is the purpose of this article to show both theoretically and practically something of the design and construction of small dynamos. I have taken a half kilowatt (500 watt or .67 H.P.) dynamo for an example. (One horse-power=746 watts: 1 kilowatt=1000 watts).

Suppose we desire a 50 volt dynamo that is to be driven at a speed of 1,800 r.p.m. and which is to have a capacity of one-half kilowatt. That is all we know to start with. There would be several sizes of machines that would give one-half kilowatt, but at first we assumed a speed of 1,800 r.p.m., so now we are limited by the strength of magnetic field we employ and the number of turns of wire on the armature. From an every-day knowledge of dynamos we can obtain a fair idea of the size of armature core we need. Let us try one 4 inches in diameter and 4 inches long; that will make an armature cross-section of 16 sq. in. Assuming that we have 40,000 magnetic lines of force (flux) per square inch, this yields a total flux of 640,000 lines thru the core. From the permeability curve (Fig. 1) it is evident that 40,000 lines of flux per square inch is a reasonable value. It is best to choose a low value because it requires less energy thru the field winding to produce it. Now we can calculate how many armature turns will be required with this assumed flux to generate our 50 volts. We will compute this by the formula:



Magnetization Flux Density Curves for Cast and Wrought Iron, and Diagram Showing Path of Flux in Bipolar Dynamo.

$$Volts = \frac{\phi \times N \times Z \times P \times K}{10^8 \times P^1}$$

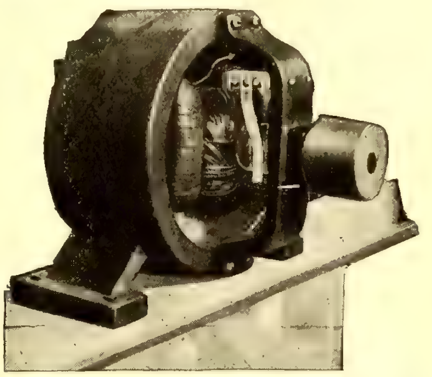
Where:

ϕ = flux thru armature
N = speed per second of armature
Z = No. armature inductors
P = No. of poles
P^1 = No. of paths thru the armature
K = factor pole pitch.

In the above formula the factor K, appearing above the line, may be explained as follows: The ratio of the arc subtended by the field poles, to the arc on the circumference of the armature is considerably less than unity and in a machine of this type the factor is taken as about .75. Substituting the proper values in the above equation we have:

(The Voltage) $$50 = \frac{640{,}000 \times 30 \times Z \times 2 \times .75}{100{,}000{,}000 \times 2}$$

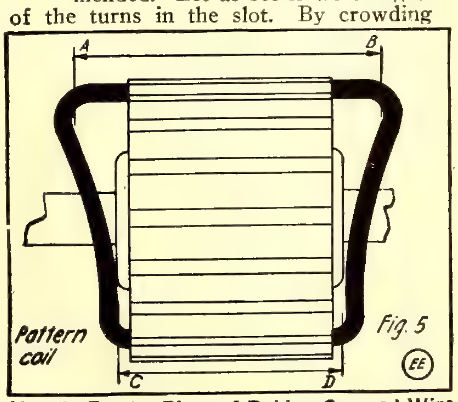
$$50 = \frac{3.6Z}{25} \qquad Z = 348$$



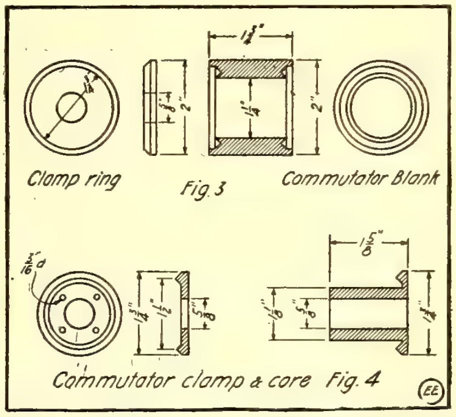
Appearance of Finished 500-Watt D.C. and A.C. Dynamo as Built with Successful Results by the Author

As 348 does not divide up evenly, we will select 360 inductors instead. Every turn on the armature goes thru two slots, so each turn constitutes 2 inductors. If we require 360 inductors we will need 180 turns on the core to generate 50 volts. Let us use armature discs with 18 slots, say ½ inch in diameter. That will make 18 coils with 10 turns per coil. If we desire one-half kilowatt, our dynamo must carry 10 amperes or better thru the *two paths* of the armature. Each path carries half, or approximately 5 amperes. Allowing 500 circular mils cross-sectional area per ampere, our armature conductors will have to be at least of 2,500 cir. mils or No. 16 or No. 15 wire. For armature windings double cotton covered wire is recommended. Let us see if we can get all of the turns in the slot. By crowding slot full of short lengths of the wire we get 30 in. Take two-thirds of 30 for the proper number to fill the slot, or 20. As our 180 turns make 360 entries of the slots or 20 per slot, our ½ inch slots will do. We will do very well to decide on a bi polar (two-pole) field. A ring type of yoke for the magnets is of better appearance and lighter than other styles, so we will use it. As the field magnet must carry 640,000 lines of flux, its cross-section should equal that of the armature. So our field magnets will be 4 inches square. It is general practise to let the field magnets enclose seven-tenths of the circumference of the armature, so with our 4 inch square poles, a space between poles of about 2¼ inches is all right. The field ring forms two paths for the flux (Fig. 2); we will permit the cross-section of the ring to be 8 inches wide and 1⅜ inches thick (area = 11 sq. in.). Now we have to determine how many *ampere-turns* will excite this magnet. We figured on needing 640,000 lines, but allowing for magnetic leakage we must figure on 750,000 lines. All this flux, we figure, has to pass thru the armature, and consequently thru the two air-gaps between field magnets and armature. The air-gap in our machine will be 1/32 inch on each side, or 1/16 inch total. With our 750,000 gross flux lines the density per sq. in. is 34,000. By looking at the permeability curve again (Fig. 1) we see that for 34,000 lines, about 24 ampere turns (A.T.) will force the flux thru the ring for a length of 1 inch. Assuming the ring to be 11 inches in diameter, the distance half way round is about 17.25 inches. So 24 times 17.25 will make 415 ampere-turns for each side. Two sides make 830 A.T. For an air gap 1 cm. long about 6,000 A.T. would be required to force our flux across, but as our gap is only .16 cm., 975 A.T. will do it. We will allow 720 A.T. for the circuit thru the magnet cores and the armature core. Summing up: 975+830+720 = 2,525 A.T

As we have a 50 volt current to dea with, we may proceed to design a shunt field.

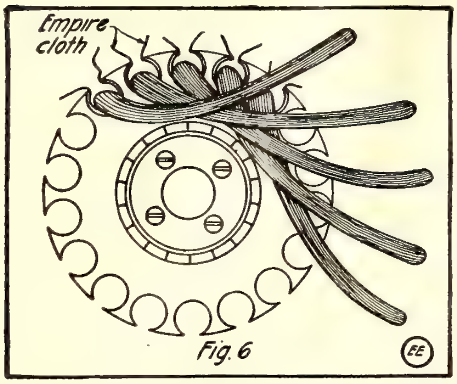


How to Bend a Piece of Rubber Covered Wire to the Form of an Armature Coil for a Pattern, from Which to Make the Other Coils.



Details of the Commutator Shell and Blank from Which Segments Are Cut with a Hack-Saw.

winding, or one that may be connected directly across the brushes. If we wind each coil with No. 21 S.C.C. magnet wire, very close to 2,500 turns per coil can be wound and the resistance of the whole field should



Showing How the Form-wound Armature Coils Are Laid in the Slots, Each Coil Overlapping Its Neighbor. The Coils Are Placed In the Slots a Few Turns at a Time, Until All Are in Place.

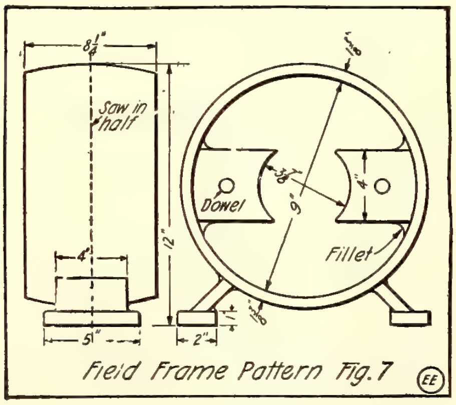
approximate 100 ohms. This will give a field current near ½ ampere and will magnetize it.

A small field rheostat should be included in the field circuit to raise and lower the voltage as desired.

Possibly we could have designed this dynamo for higher speed and then it could have been smaller. But high speed is very undesirable as the bearings wear faster and sparking and vibration are more severe. If we had used a 3 inch armature a very high speed would have been necessary to obtain our output. And if we had used a 5 inch core, the cost would have been unnecessarily high. Of course if a low speed like 1,200 r.p.m. were required, a large machine would have been the only solution.

In this machine it is proposed that the builder make his own pattern for the castings. The field casting here described has been computed for cast iron, but may be of cast steel; if cast iron is used, the capacity of the dynamo will not be as much. The cast iron cannot carry magnetic flux as well as soft steel (for reduced magnetizing power required for steel, see any dynamo text-book).

We will build the armature of the dynamo first. Procure a stack 4 inches high of 4 inch diameter armature discs with 18 slots. If the hole for shaft is ⅝ inch or better all right, but if smaller, it is best to ream the holes out with a taper reamer.

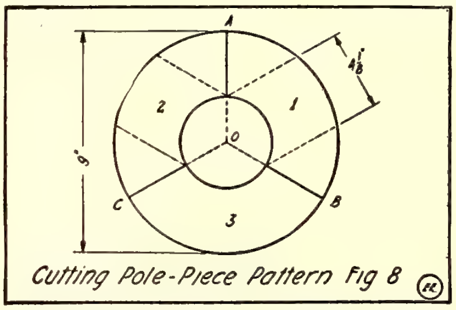


Wood Pattern for Dynamo Field Magnet Frame.

The shaft is made from a piece of cold rolled steel ⅝ inch in diameter and 17 inches long. Center this at each end in the lathe. Turn out two brass or iron clamp washers according to Fig. 3. Braze or sweat one on the shaft 6 inches from one end. Put on the discs so that the slots line up. Then put on the other clamp washer and screw the core tightly together in a vise and sweat the washer on. That finishes the core.

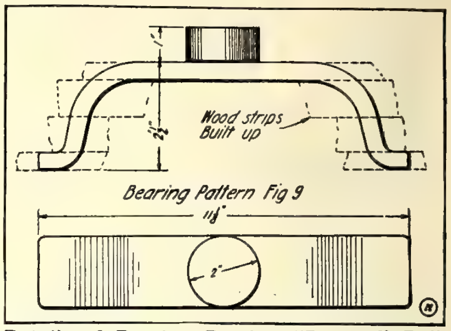
If the builder has no commutator and prefers to make it, that can be done as follows: Turn a brass or copper blank (Fig. 4) and saw the segments with a hacksaw. File off all raw edges. Then cut up a stack of sheet mica resembling the cross-section of the segments. See Fig. 3. They do not have to be cut exactly, as the commutator is turned down when all assembled. A stack about ½ inch high will be needed. Turn out a brass or iron core and a clamp ring. See Fig. 4. This core is insulated with mica. The clamp-edges of the core and ring are insulated by mica washers. Assemble the segments on the core with their mica insulators. Put a rubber band around it temporarily. Use plenty of shellac. If the core seems too large, put in more micas between the segments. When the segments fit, bolt the whole together tightly and bake in an oven. Putting a commutator together is tedious and annoying and so do not be surprised if you lose your sweet disposition momentarily while doing it. After baking, the commutator is turned down smoothly.

How to wind the armature. We will make form-wound coils. With a piece of No. 14 rubber covered copper wire you can form a single turn on the core as a pattern of a coil. This pattern coil is put



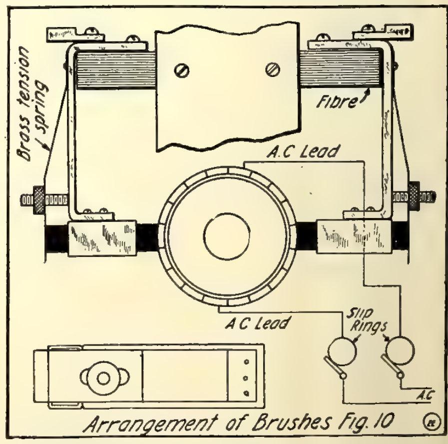
The Field Magnet Cores (Pattern) Are Cut from a Wooden Ring of the Dimensions Shown Above.

thru diametrically opposite slots (Fig. 5) and one side is made to occupy the bottom of one slot while the opposite side is in the top of a slot, and is made longer to allow coils under it to pass. Measure AB and CD. Take the pattern out and measure total length. Subtract the sum of AB+CD, which leaves the length of the sides. Now you can drive four pegs in a board with the above distances between pegs. Wind the coils on this form. The board can be mounted on a lathe face-plate. Wind 18 coils with 10 turns (No. 16 D.C.C.) per coil. Before taking each coil off the form, tie two sides with string so it can not unwind and twist a loop in the beginning end of the wire so that the terminals can be distinguished later. Now place a piece of Empire cloth (oiled linen) in each slot (Fig. 6) large enough to form a lip on each side of the slot. Wiggle the turns of the short side of each coil into the bottom of each slot, with the terminals towards the commutator. This done, connect the coils all together, beginning to end, all around. Then work the long sides of the coils towards their respective slots and wiggle all the wires into the slot. Trim off the surplus Empire cloth to within about ¼ inch from the core. Tuck these edges in the slots. Then a fibre wedge can be driven in each slot closing it. Paint the winding well with insulating varnish and bake it dry. Then solder the leads to the commutator bars. Each end-lead of a coil goes to a bar 90° distant from the slot for the brush arrangement here shown; if the brushes are in line with the space between the field poles, then the coil leads are brought over straight to the commutator. The armature may be tested for grounds or shorts. Better do that for the commutator before soldering any leads on.



Details of Bearing Bracket "Pattern" Built up from Successive Strips of Wood Glued Together. This Is Used to Make the Casting With.

The next thing is to get the field casting made. First, a pattern of the field magnet must be made of wood suitable for the foundry. Cedar or white pine well seasoned may be used. The field ring will be the first part of the pattern to make. Make a paper segment ⅓ of a circle 12¼ inches outside diameter and 8¾ inches inside diameter. With this pattern mark and cut a stack of wooden segments to make up a hollow ring 8½ inches high. Join the radial edges up neatly with a plane and glue the whole stack together on a wooden board bolted to your lathe face-plate. When the glue is dry turn it down smoothly till it measures 11⅞ inches at the edges and 9 inches at the center. Turn the outside of the ring till the wall is a little over 1 inch at the edges and nearly 1⅜ inches at the center. Knock off the face-plate board and finish the remaining edge with the plane. Now the field poles. Make more wooden segments 9½ inches outside diameter and 3½ inches inside diameter. Make a ring 4¼ inches high. Turn it down to fit the inside of the field ring. The inside is turned to 3⅞ inches. Now take this ring and saw radially, cutting it in thirds. (Fig. 8.) Take one of the thirds and rip it in half, making two pieces the same shape as the other thirds, only they are half as thick. Glue these halves on No. 1 and No. 2, making each better than 4 inches thick. Now you may proceed to cut the pole pieces out of these two wooden blocks.



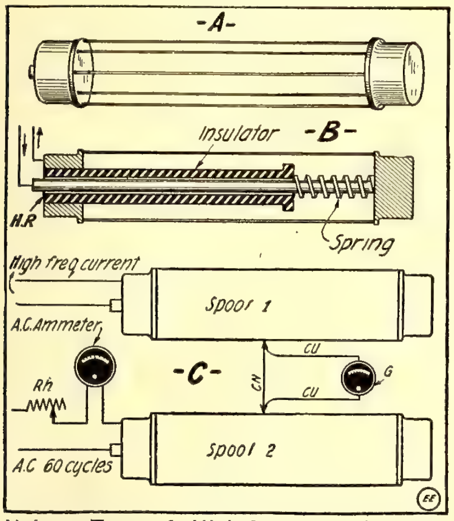
Arrangement of Brush Gear and Connection of Slip Rings to Commutator when A.C. Is Desired.

This idea makes your pattern with minimum waste. Economy may be worth while

(Continued on page 932)

A Novel High-frequency Ammeter

A VERY interesting type of high-frequency ammeter is described by E. F. Northrup and R. G. Thomson in the journal of the *Franklin Institute*. The va-



Unique Type of High-frequency Ammeter which Operates on the Comparison Principle; the 60 Cycle A.C. Is Varied Until Zero Deflection Is Obtained on Galvanometer G, when the Heating Effect in Spools 1 and 2 Is Equal.

rious parts of the instrument are shown schematically in the illustration. On a cylindrical frame there are twelve No. 38 Manganin wires supported as shown at A. The length of the wires between the brass-end rings of the spool is 3½". Care should be taken to solder the wires in such a manner that each one has exactly the same length and resistance. The wires are maintained taut by means of a spring as seen at B. Current is led in to one end of the set of wires along the axis of the cylinder. Two of these cylinders are made exactly alike. One of these cylinders, which is called the spool, carries the high-frequency current, while the other carries the comparison current. When the currents thru each of the spools have the same effective value, the heating effect of the current of each spool is the same, not only for the spool as a whole, but for each individual wire.

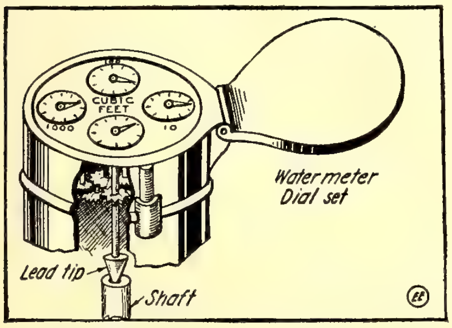
By connecting together near the middle point one wire of each spool with a piece of very fine Constantan wire, CN (see Fig. C), and also by fastening the points of juncture with fine copper wires, a thermo couple is produced which is connected to a sensitive galvanometer. This gives a very delicate indicator of the condition that the two spools are carrying currents having equal heating effects.

The procedure in measuring the high-frequency current consists in passing this current thru spool No. 1 (Fig. C), and 60 cycle alternating current in series thru an ammeter, an adjustable rheostat and spool No. 2. Then vary this latter current until the galvanometer attached to the thermo couple gives no deflection. When this adjustment is made both junctions of the thermo couple are at the same temperature, and assuming the spools to be identical and under like conditions in respect to loss of heat, the effective values of the high-frequency current and the low-frequency comparison are the same. Sixty cycle alternating current is used instead of direct as a comparison current, for the reason that when direct currents are used, some of this current finds its way thru the galvanometer with the best attachments of the thermo couple junctions to the wires which it is practical to make. This difficulty is avoided by the use of the alternating current.

While it is impossible to make two spools which are in all respects identical and which lose their heat at the same rate, the lack of symmetry was provided for and made to have no influence by shunting the spool of higher resistance until, on the passage of equal measured currents of low frequency thru each spool, the galvanometer deflection was reduced to zero. In using the meter for measuring the high-frequency current, the low-frequency current was past thru the shunted spool, because a low-frequency current will divide between the wires of the spool and the shunt, according to Ohm's Law, while the high-frequency current will not so divide. To insure uniformity in its performance the meter was mounted in a tin box and immerst in paraffin oil. From all the experimental data obtained it was assumed that the error in measuring the effective value of the high-frequency current did not exceed 5%. An instrument of this kind will prove very useful in the experimental radio or electrical laboratory.

A SIMPLE SPEED INDICATOR.

The only material necessary to make this speed indicator is the integrating gear movement from an old water, gas or electric meter, which may usually be obtained from the city engineer or the water company for the asking; also, a piece of brass



A Speed Indicator Can Be Readily Constructed from the Integrating Mechanism of a Water, Gas or Electric Meter.

or lead of the shape shown in the drawing.

The lead or brass piece should be turned in a lathe so as to have a conical shape. A small hole, a little smaller than the end of the shaft of the "unit dial" of the meter, should be drilled exactly in the center of the cone. The shaft and hole are then threaded and screwed together. The conical-shaped piece on the end of the shaft is to be prest into the center hole on the revolving shaft.

To use this indicator simply read the figures on the meter, place, the conical-shaped piece of lead against the end of the revolving shaft and hold it there for one minute by the watch, and then note the reading. The numerical difference between the two readings will be the "number of revolutions per minute" at which the shaft revolves.

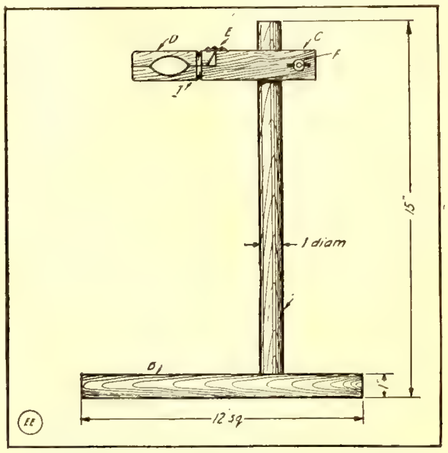
Contributed by FRANK SAHLMAN.

A STAND FOR AN X-RAY TUBE.

The stand described here was made for an X-Ray tube but will also be handy for various electrical and chemical experiments.

The stand consists of a baseboard B which carries a round stick, which in turn supports the holder C. This holder consists of two separate pieces, C and D, which are jointed together by the hinge E. A rubber band, I, holds C and D together and supports in this way the X-Ray Tube. (*It is preferable to drill a hole X and pass a machine screw, with wing nut, thru it.—Ed.*)

To fix the holder at a convenient height we have a bolt, F, which passes thru a hole in C and which carries a wing nut, G. A slot ⅛" wide is cut from the hole for the stick to the end of C and by tightening up the nut, G, we can camp C firmly



An X-Ray Tube Stand which Any Experimenter Can Make.

against the upright and hold it securely in any position required. This stand is very easily made as the hinges, E, the washers, H, bolt, F, and wing nut, G, can be procured from any hardware store and the wooden parts should present no difficulties.

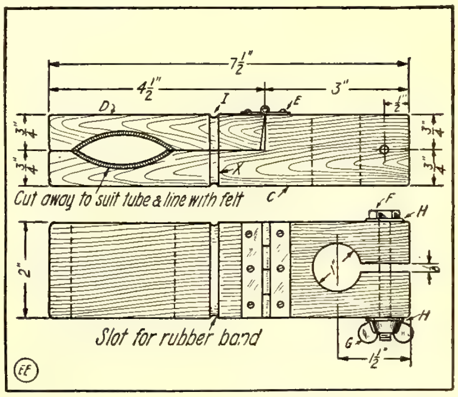
We start with the baseboard, B, which is 12" square and 1" thick. Plane a piece of wood to the dimensions given and drill a hole 1" dia. thru the center.

Procure a stick 1" diameter and 15" long and glue it into the baseboard. A glass rod may be used by those who want to make the best possible job of it, but a wooden stick will do all that is required for ordinary purposes. Next plane a piece of wood to the following dimensions: 7½" long, 2" wide by 1½" high. This gives us parts C and D. Cut a part 4½" long by ¾" high away and we have C.

A hole 1" diameter is now drilled thru C, 1½" from the end; also a slot ⅛" wide is cut from this hole to the end of the piece C.

We can now cut the shaded part out of C and D (to suit the tube) and line it with felt; also cut two small slots I, so that the rubber band cannot slip.

The hinge E is next attached to D and C and a hole for the bolt F is drilled about ½" from the end. The bolt F and wing nut G may be about ¼" 20 thread and the washers, H, are bought to suit the bolt and nut.



Details of X-Ray Tube Supporting Strip. May Be Made of Proper Size to Fit Any X-Ray Tube.

A stout rubber band, I, is slipt over the jaws C and D and the stand is completed.

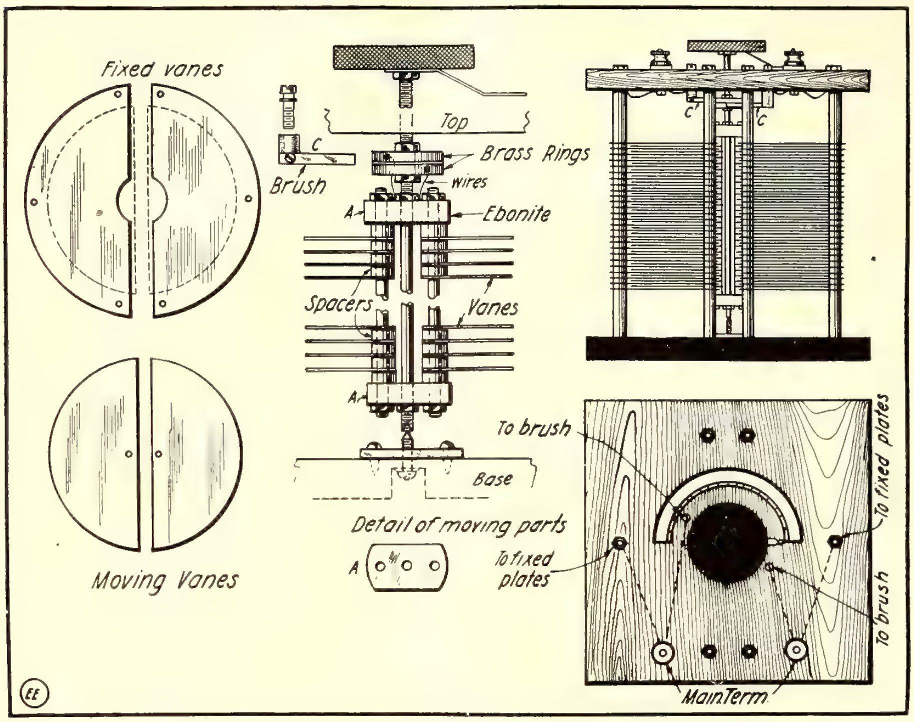
Contributed by C. A. OLDROYD.

DOUBLE CAPACITY ROTARY VARIABLE CONDENSER.

By G. Merton Bingham (Public Works Dep't., Gisborne, N.Z.).

In the sketch of this novel variable condenser no sizes are given as these may be left to the discretion of the maker.

Two sets of fixt plates and two sets of movable plates are required and these are cut and drilled as shown in the drawing. The supports for the moving plates may be ⅛-inch brass rods with ebonite (hard rubber) spacing supporters as shown at A. There is a pair of slip rings, each of which is connected to a set of movable plates. Thus the two sets of movable plates are not mutually in electrical connection, but connection is made to each of them by means of two brushes C.



An Innovation in the Design of Variable Air Condensers Whereby Twice the Capacity Is Obtained for a Given Volume, Compared to the Ordinary Type with which We Are Familiar. When Rotary and Fixt Plates of Like Sign Intermesh Then We Have Minimum Capacity in This Case, and Vice Versa.

Connections are also made to the two sets of fixt plates and the fixt and movable plates are connected to two main terminals as clearly indicated.

The action is as follows: When the plates are in zero position the movable plates and fixt plates in one half are of one sign, say +, and the movable plates and fixt plates in the other half are —. The only capacity effect, therefore, in this position, is that due to the edges of the plates across the gap, which is of course slight.

When the condenser shows maximum capacity, the fixt plates on one side are of the same sign as the moving plates in the opposite half and vice versa. Thus in a condenser of this design it is possible to obtain approximately *double* the capacity of one of the ordinary type of the same size. The sketch shows all other details which may be required. Rollers from ordinary bicycle chains make excellent spacing washers for the plates.

HINTS TO RADIO AMATEURS.

It has been my experience that every set of experiments I have ever made, not only proved an interesting pastime, but also added to the range of whatever radio station I happened to be working. This was particularly true in an old government station which had a working range of thirty miles on one kilowatt and could receive only fifty miles. The sending end was hopeless, I never transmitted more than seventy-five miles with it, but I did accomplish 1,400 miles with the receiving set; this being very good at that time, considering the outfit, which most amateurs even would be ashamed to own.

Many interesting and helpful experiments may be performed with a wave meter. Many more investigations can be made with the aid of a galvanometer and a Wheatstone bridge. Articles in THE ELECTRICAL EXPERIMENTER from time to time have given details of the above named apparatus in several forms, at a low cost.

Experiment with a piece of wire, say fifty feet long; measure its wave length straight, and wound in coils of various sizes. Measure the current received thru various gages of wire and compare the current received thru coils wound with bare wire and insulated wire, and try to find or measure the comparative loss due to dead ends. But before proceeding with these tests, see that your aerial is well insulated and that the resistance of the connections is reduced to almost zero by properly soldered joints. Record the results and you will have the information with which to build a loose coupler of the highest efficiency and you will know just why you get the best results with it.

Money can often be saved by intelligent investigation and at the same time better results can be obtained. Hard rubber is ordinarily a better insulator than wood which has been boiled in paraffin, but in a station situated near the ocean the sending condenser plates were insulated with hard rubber, which was coated with moisture the greater part of the time. This caused a brush discharge which finally burned several paths from plate to plate and partially short-circuited the condenser. In this instance paraffined wood or fiber would have given better results with much less expense.

It will be seen that experiments carried on in the proper way will benefit the experimenter in many ways. They furnish a source of interest and amusement; they aid in the efficient design of apparatus; in some cases the saving of money is effected; and the amateur can work out the answers to the many puzzling questions that crop up without outside assistance. Therefore I advise every owner of wireless apparatus to be not only an Amateur, but an Experimenter as well.

Contributed by
E. GREENWOOD FRACKER.

HOW TO MAKE A SYNCHRONOUS ROTARY GAP.

To make a synchronous rotary spark gap motor, an ordinary Knapp type "SS" dynamo-motor is fitted with two A.C. collecting rings as shown in the drawing. Brushes are fitted to the rear casting so as to make contact with the rings. Leads are brought from two diametrically opposite segments in the commutator to the two collecting rings as shown.

To start the motor put a rheostat in series with the shunt field and start it from the D.C. side. A 12-volt lamp is placed in series with the twelve volt step-down A.C. transformer used to run the gap as indicated.

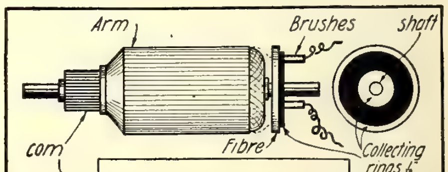
As the motor speeds up fast enough the lamp will alternately burn dim and bright. The alternations will become slower as synchronism is approached, and will finally be so slow as to permit closing the lamp shorting-switch as soon as the lamp dims. The armature circuit from the battery may then be opened; the field circuit being left closed.

In starting, if the motor does not run up to the right speed, so as to dim and light the lamp, adjust the field rheostat FR, until it does. This rheostat should have about 10 ohms resistance and be finely adjustable.

When the motor is running from the A.C. circuit it makes one revolution for every cycle, or 3,600 R.P.M. at 60 cycles. To get a 480 cycle tone use 8 points on disk; for a 6,000 cycle tone use 10 points.

Care should be taken to see that the rotary spark gap disc is thoroly insulated from the motor shaft or else there will be a tendency for a break-down between the armature winding and the shaft.

It was found that the radiation in the antenna was greatly increased when this gap was used instead of the old non-synchronous gap, and furthermore, the spark is always clear and steady. This gap has given very good results.

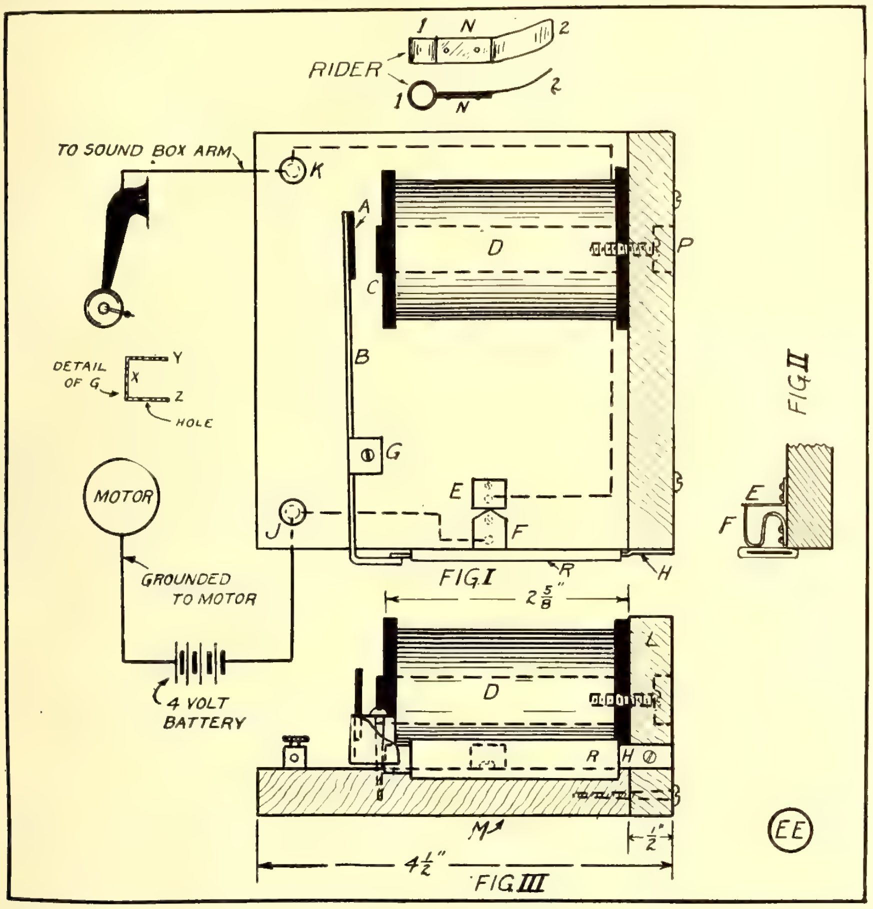


Details for Building a Synchronous Rotary Spark Gap, to be Operated From Step-down A.C. Transformer.

Contributed by
CLARENCE MUELLER.
(call—9EE.)

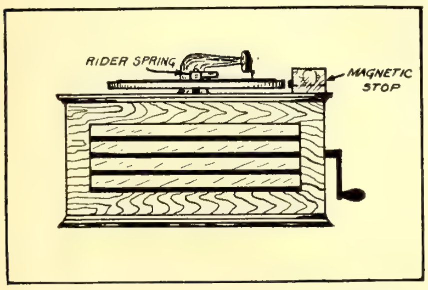
An Automatic Electric Phonograph Stop

By following the instructions below any experimenter can make a very good automatic electric stop for a Victrola or other talking machine. As indicated by the figure, D is an electro-magnet 2⅝ inches long and 1½ inches in diameter. An old motor



Arrangement of Home-made Automatic Electric "Stop" on Disc Style Phonograph. The Electro-magnetic Brake Circuit Is Closed by the Moving Sound Arm Making Contact with a Spring at the Center of the Record Table.

field or an electro-magnet from an arc lamp or a large size electric bell is just the thing. One can be made by winding about 5 layers of No. 18 double cotton covered, magnet wire on a ½ inch carriage bolt, which has been properly annealed. This is fastened to the end piece L by means of a machine screw P, passing into the magnet core. The trigger B is made of a copper or brass strip ½ inch wide and about 3/32 of an inch thick. The pivot G consists of a piece of brass strip bent as shown in the illustration. The side X is soldered to the trigger B, about 2½ inches from the armature end. The sides Y and Z have holes drilled in them to per-



Front View of Automatic Electric "Stop" on Disc Style Phonograph.

mit a round head wood screw to pass through into the base of the instrument. A is a one inch round or square soft iron disc soldered on one end of the trigger. H is a piece of spring steel from an old clock with a piece of rubber tube R, slipt over it as shown.

E and F is the automatic circuit-breaker. It consists of two pieces of brass ribbon cut and bent as shown in Figs. 1 and 2. The electrical connections, given in Fig. 1, are made to the two binding posts J and K.

The instrument may be fastened to the phonograph by removing one of the screws which hold the motor board in place, and substituting the screw for one of the same kind but ½" longer, this extra half inch being used to pass thru the base of the automatic stop. The stop is placed so that when the spring H, is released from trigger B, it will bear with sufficient force on the revolving record table to arrest its rotation. When the spring is held in place by trigger, the two contacts, E and F, should make perfect electrical connection with each other. But when the spring is released, this connection should be broken, thus cutting off the current.

The rider N, is made of copper or brass bent as shown and having the hole 1, just large enough to make a snug fit over the screw at the center of the revolving table. A record is now placed on the machine, the rider just made is slipt over the screw, and the end 2 is bent so as to make contact with the sound-box arm just as, or a little after, the point where the phonograph ceases to play.

Everything being connected as shown in Fig. 1, the operation is as follows:

At the end of the record the rider N, comes in contact with the sound-box arm, thus closing the circuit of which magnet D is a part. The magnet, thus being energized, attracts armature A, which is fast to trigger B. Trigger B, in turn, releases spring H, which then flies off to the side, bearing on and stopping the revolving table. The spring H, on being released, allows the 2 contacts E and F to separate, thus breaking the circuit.

Contributed by
CHARLES HANAUER, JR.

A NEW ELECTRIC SOLDERING IRON.

A soldering iron operating on the principle of a welder can easily be constructed by following the description. The iron has several advantages over the old type, principally quickness and ease of operation and low first cost. The current is used only while the actual process of soldering is taking place.

The handle for the device consists of a fiber tube ¾ inch in diameter and 4 inches long. A piece of ¼ inch square brass rod 8 inches long is bent at one end as shown in the illustration. Two holes are drilled and tapt in one side of the rod so that it may be fastened to the handle.

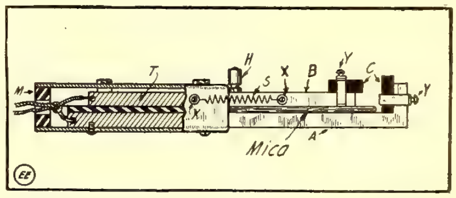
A piece of ¼ inch square brass tubing 3 inches long has two bolts soldered to it so it can also be bolted inside the fiber tube. A ¼ inch square brass rod 4 inches long, as shown at B, is next obtained, and small pieces of brass are soldered to it and the brass tube, to form hooks for the small spring shown at S. The rod B is also drilled and tapt to take shank of knob H.

Two small pieces of carbon are filed or cut ¾ inch long and ¼ inch square, as shown at C. Two clips are required to hold these carbon electrodes, and can be made from strips of brass ¼ inch wide and 1¼ inches long, bent as shown in detail with holes bored thru the overlapping ends. The clamping screw and nut must be assembled as shown, because it is impossible to solder them, due to the heat generated at these carbon blocks.

We are now ready to assemble the soldering iron. The flexible cord leading to the iron should be 6 or 8 feet long, and is first led thru the bushing M on the rear of the handle and a knot tied in it. The leads are soldered to the tube and rod before clamping them into place.

The rod B may be slid into position and the small springs slipt into place. A sheet of mica may be placed between the brass tube and rod to prevent short-circuiting. It only remains to clamp the carbon blocks into place to complete the assembly.

To use the iron slip the upright carbon back of the wires to be soldered and the



An Electric Soldering Iron that Is Different. It Is Convenient to Hold and when the Button "H" Is Prest Forward the Joint Is Clampt Between Two Carbon Blocks "C". The High Resistance Contact Results in Heating and the Solder Is Applied in the Usual Way.

other carbon pushed forward by knob H to clamp the wires between the blocks. The poor contact results in a comparatively large amount of heating of the wires to which the solder is applied with the free hand.

A suitable resistance will have to be used in series with this electric iron, preferably a water rheostat or lamp bank to keep the input down to 5 amperes. The handle should be covered with insulating tape to prevent short-circuits.

Contributed by THOS. W. BENSON.

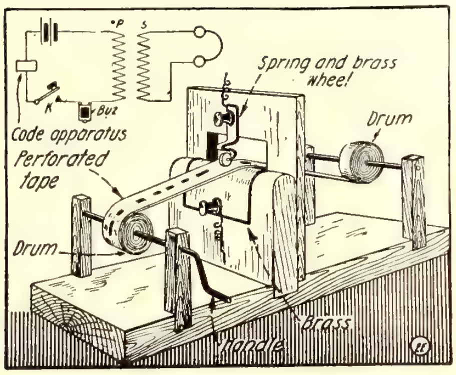
This department will award the following monthly prizes: **First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.**

The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of **$3.00** is awarded; for the second best idea a **$2.00** prize, and for the third best a prize of **$1.00**. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

SECOND PRIZE, $2.00

A PERFORATED TAPE CODE TEACHER FOR STUDENTS.

Most of the articles that appear in this department are intended for amateurs who can receive, and this contribution is given for those who cannot read the code. He



A Perforated Paper Tape Passing Between Two Brass Contacts Opens and Closes a Buzzer Circuit in This Code Teacher.

can easily make this apparatus which will send code both slow and fast as the speed can be varied nicely.

The dimensions are immaterial and may be made to suit the experimenter. The woodwork of this apparatus is very simple to make. The four small legs are mortised into the base so as to give greater strength. The brass parts are made as shown in the sketch. The paper tape is made by taking a strip of heavy paper (photograph or other binder rolls, cut into ½" strips); the dots and dash perforations are punched in with a regular ticket punch, care being taken to keep the spaces even between the characters and also the spaces between the dots and dash perforations. The accompanying hook-up is a good one, as it also gives the experimenter a chance to become accustomed to the loose coupler.

Contributed by HENRY J. LEISNER.

FIRST PRIZE, $3.00

A 4,000 METER "VEST-POCKET" RADIO SET.

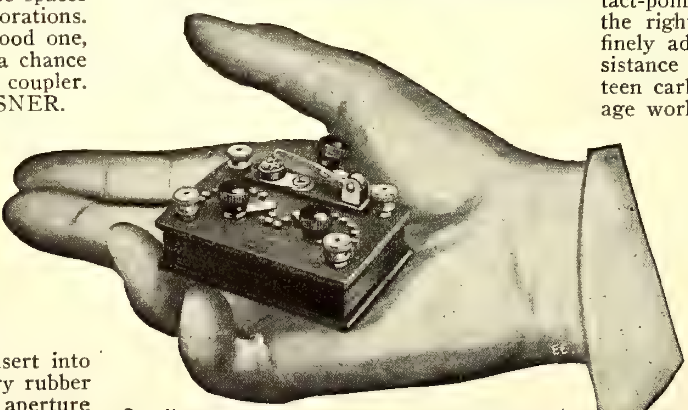
The accompanying photograph shows a hand-made "vest-pocket" wireless receiving set which will tune up to 4,000 meters. The case is made of ⅛ inch cigar box wood, and measures 3 inches long, 1½ inches wide and ⅞ inch high. The binding posts were taken from old dry cells the contacts made from filister-head screws with the heads filed down and the switch arms cut from sheet bronze. The knobs are E. I. Co., standard ones; the knob at the left controlling eleven points on the primary, while the one at the right controls the same number on the secondary winding. The transformer is wound with No. 36 double silk-covered copper wire, multi-wound and staggered.

The ⅛" square brass detector arm, soldered in a steel ball, gives every movement required for crystal adjustment. The cup is also sliding and fitted with a set-screw for clamping crystals, while a tiny condenser is included and shunted across the 'phone posts. All metal parts are nickeled.

With a piece of galena, this set has successfully recorded Arlington at night and tests have been made in the office of J. H. Bunnell & Company, New York City, where it was found possible to copy "Wanamaker's" at Philadelphia, Fire Island, Sea Gate, Brooklyn Navy Yard, and a score of others, ranging from 200 meters wave length to 4,000, which is the total capacity of the set.

It is actually *Arlington in your hand*, and it does some work that ordinarily would be expected from a standard receiving set, as the signals come in *clear and loud*. 3,200 ohms receivers are used with it.

Contributed by HERBERT E. HAYDEN.

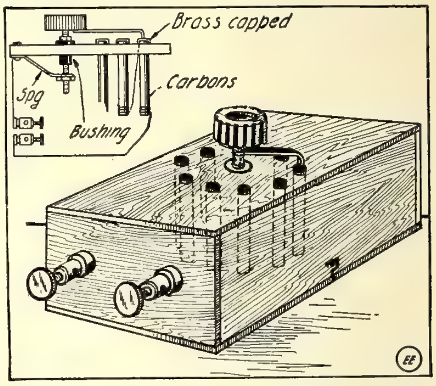


Smallest of Radio Receiving Sets. It Has a Range of 4,000 Meters Wave Length and Fits the Vest Pocket.

THIRD PRIZE, $1.00

RHEOSTAT MADE FROM FLASH-LIGHT BATTERY CARBONS.

To make this unique and efficient rheostat procure a cigar-box about 2½ inches in depth, and in the back panel drill a series of holes about 7/32 inch in diameter,



Efficient Rheostat for Experimental Work, Constructed from Flash-Light Battery Carbons Having Brass Caps.

arranged in a semi-circle as for any "tap" switch. Then obtain some old flashlight batteries and remove the brass-tipt carbon rods. Force these rods thru the holes in the cigar-box, leaving the brass tips only projecting on the outside. Mount an ordinary rotary switch on the panel with the lever touching the brass caps as it is rotated.

The carbons should be connected in series, with leads brought out from the switch blade and from the first carbon in the series. Two binding-posts may be mounted on the end of the cigar-box, with the two leads connecting to the binding-posts. The brass caps make excellent contact-points and the carbons have just about the right resistance to make the rheostat finely adjustable, by adding very little resistance at a time. About twelve to fifteen carbon rods should be used for average work.

Contributed by
JOHN S. WILLIAMS.

REPAIRING STORAGE BATTERY TANKS.

A successful method of repairing cracks in the hard rubber tanks used as containers for the electrolyte and plates of storage cells is as follows: Remove the plates and electrolyte, thoroly dry the rubber wall, and when dry widen the cracks by using an old hacksaw blade. This done, insert into the now widened crack an ordinary rubber band of sufficient size to fill the aperture fairly well. Sprinkle over the band a little sulfur, and apply a hot soldering iron, thus subjecting the broken surface to a vulcanizing process. Tank is ready for immediate use, and will be found as tight as when new.

Formulas for Flux and Solder:—The following fluxes will be found desirable to use for soldering and welding various metals:

For steel and iron use salammoniac or borax; for zinc use chlorid of zinc; for lead use tallow or resin, and for brass use salammoniac or sulfuric acid.

The best solders for different metals are as follows:

For lead use two parts tin and three parts lead; for tin use one part tin and two parts lead; for aluminum-bronze use four parts copper, four parts zinc, and three parts borax; for aluminum-brass use seventy parts copper, thirty parts zinc and five parts aluminum. A mixture of tin and bismuth in the proportion of 86 to 14 per cent is also good. For bronzing use half copper and half zinc.

Contributed by W. E. Rhodes.

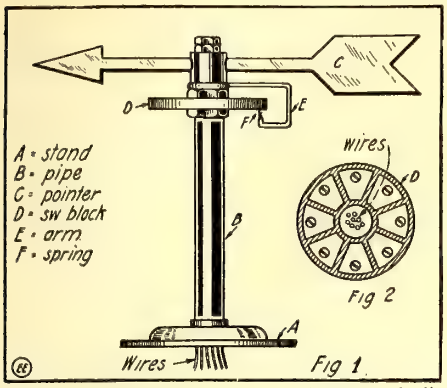
SIMPLE BATTERY INSULATOR.

Sometimes the porcelain insulator, which separates the zinc from the carbon in a carbon cylinder battery, becomes lost or broken. A substitute can be immediately supplied by breaking the neck from a bottle and inserting this in the battery in place of the porcelain.

Contributed by K. M. COGGESHALL.

AN ELECTRIC WIND DIRECTION INDICATOR.

In Fig. 1, A is the stand; B the pipe standard; C the pointer; D switch block; E the switch arm and F the spring contact. The switch block D is fastened securely



Home-made Electric Wind Direction Indicator, which Enables You to Know How the Wind Is Blowing by Means of an Annunciator.

to the pipe B, while the vane, pointer and arm revolve with the wind. Fig. 2 is a view of the switch block and the wires in the pipe which are connected to the various metal segments, each one corresponding to a different point of the compass, as N.—N.E.—E., etc.

The wires are connected to an eight-magnet annunciator or flash lamp board, properly labeled.

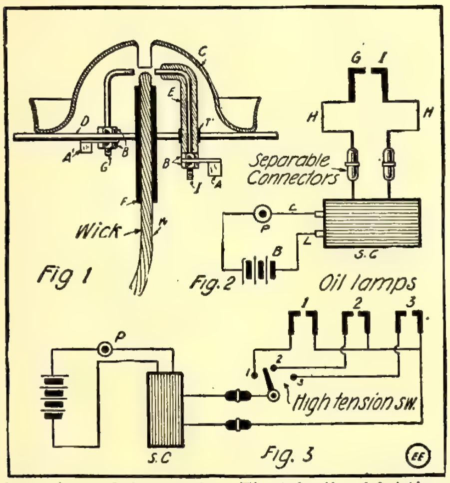
The arm E makes contact with a particular metal plate when the pointer is in a certain position, as becomes apparent.

Contributed by H. CARLETON WHITE.

LIGHTING OIL LAMPS BY ELECTRICITY.

The accompanying diagram shows an arrangement I use to eliminate the disadvantages of oil lamps. Fig. 1 is a cross-section of an ordinary oil lamp burner, in which C is the slotted cap; D, the perforated base; F, the oblong tube which holds the wick W. G, is the grounded terminal and consists of a piece of rod or wire, about 1/16 of an inch in diameter, bent, and threaded on one end as shown. It is held in place by the two nuts, B.

The insulated terminal is seen at I and it is also made of 1/16 inch rod, but it is run thru the glass tube, E, which is bent in an



Ingenious Scheme for Electrically Lighting Oil Lamps, Utilizing the Jump Spark Coil. One Spark Coil May Be Used to Light Several Lamps when So Desired.

alcohol or gas flame, to conform to the rod I. I is first cut to the proper length and inserted in the tube E, then they are bent as shown. I is held in place by the two rings of asbestos cement, T, T^1 (one on either side of the base, D). A and A^1 are the terminals to which the high tension cables are attached.

Fig. 2 is the wiring diagram in which B is the battery; L, L, are the primary wires; P is the push button; SC is the spark coil (about 3/16 to ¼ inch spark rating is sufficient); HH are the high tension wires; I is the insulated terminal and G is the grounded terminal. To use it it is merely necessary to turn the wick up so that the spark between I and G will pass thru its upper end. To facilitate refilling the lamps the leads HH should be provided with separable connectors, one in each high tension lead. One spark coil will light a number of lamps, a high tension distributor switch being used to switch the spark from lamp to lamp, Fig. 3.

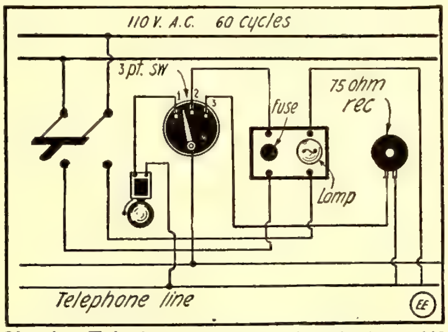
Contributed by PARK GOODE.

A 110 VT. A.C. TELEPHONE.

I was considerably in need of a telephone, and not desiring to buy one, I made my own plans as described herein, which produced very satisfactory results. It works on 110 volt current, using No. 14 iron wire with 500 feet between stations.

To ring second party, place switch lever on point 2 and close D.P.S.T. switch. This will then ring the party.

To talk put switch lever on point 3 when both parties can converse; that is, you talk and listen over receiver. Leave switch lever on point 1, when other party can ring you. A battery may be connected in series



Simple Telephone Circuit Employing 110 Volt A.C. Thru Lamp to Ring Bell. Receiver Is Used for Talking and Listening.

with the 75 ohm receiver to improve the talking quality. Use a 16 C.P. lamp in one socket and a 2 ampere fuse plug in remaining fuse receptacle.

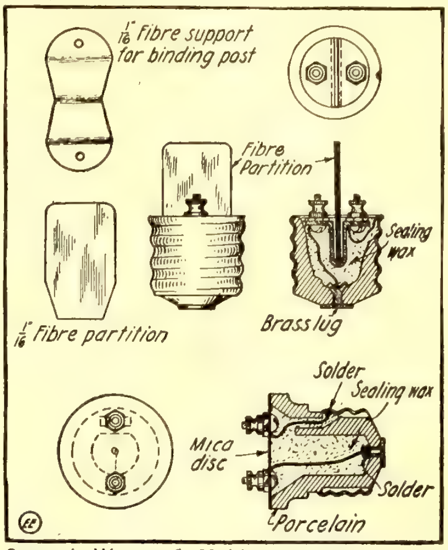
Contributed by RALPH AGNEW.

HOW TO MAKE CHEAP ATTACHMENT PLUGS.

An extension plug, which is very convenient for experimental purposes, may be made from the base of a broken lamp or from a blown plug fuse.

If the lamp base is used, the glass should be entirely removed, taking care not to break off the two wires, the ends of which should be scraped bright. Cut out two pieces of sheet fibre or heavy cardboard, soaked in melted paraffin, having the shape indicated in diagram. Then two holes should be cut to admit the screw of two small binding posts, and the piece should then be bent on the lines shown to form a "T." Fasten the wires to the under side of the binding posts and see that the piece fits into the lamp base just about flush with the top, or a little lower, with the partition piece in place. Warm the parts slightly, then nearly fill the base with melted sealing wax and quickly press the two pieces into place. The partition separates the contacts and serves as a handle to screw the plug into place.

When the blown plug fuse is used, after the metal cap is removed, it will be necessary to solder wires to both center contact and the outside threaded shell, where the fuse wire was connected. Two holes punched in the mica disc will hold the binding posts, and the cavity should be filled



Several Ways of Making the Ever-Useful Attachment Plug from a Discarded Fuse Plug or Lamp Base Are Shown Above. The Extra Parts Required Are Mostly Scrap.

with sealing wax as in the case of the lamp base.

While these plugs can not be used for permanent hook-ups, they are very handy for experimental or emergency work, and can be made very easily from material readily available at any work bench.

Contributed by M. T. McGEE.

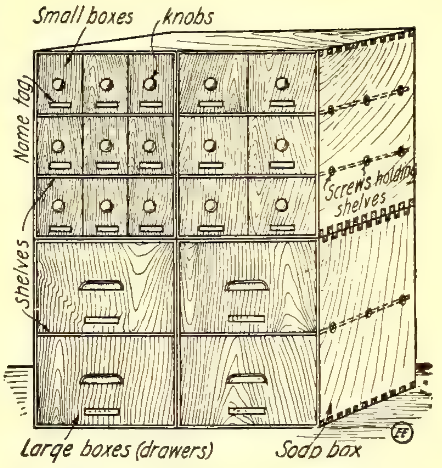
STOCK DRAWERS FOR THE WORKSHOP.

How many amateur workshops can boast of a place to keep stock in a businesslike manner?

Not many! Still it's a simple thing to do. Obtain several wood boxes, the same size, such as used for soap, etc., and build these up to form shelves. Make smaller boxes to fit in these shelves, say two to six in a large box and put a handle or knob on the front of each to form drawers. A neat and serviceable arrangement is the result.

This is especially handy for the amateur mechanic who is inclined to be too noisy in "flats" and who frequently changes his address. Simply nail a board to keep the drawers from falling out and you are "packed!"

Suitable knobs for use on the small



Why Spend Half an Hour Looking for a Certain Kind of Screw or Drill, when with a Few Small Boxes One Can Construct a Business-like Stock Cabinet.

drawers can be purchased at any hardware store; they are sold for use in repairing tea-pot covers and the like.

Contributed by LEWIS SCRIVEN.

Experimental Chemistry

By ALBERT W. WILSDON
Eleventh Lesson

COMBUSTION, FLAME AND EXPLOSIONS.

WHAT is Combustion? Doubtless this question has been asked by many readers of this series, and in the present installment we will take up the subjects of Combustion, Flame and Explosions.

Fig. 61. How the Blow-pipe Is Used in Chemical Work. A Bunsen Burner Supplies the Flame, a Part of Which Is Blown out Sidewise by the Blow-pipe.

Combustion is a term usually applied to the process of burning, which usually consists in the oxygen of the air uniting with the constituents of the combustible substance. From this we gather that there are certain conditions which must be present in combustion; 1. Something to unite, or, in other words, a combustible substance. 2. Something for this to unite with, or a supporter of combustion. The temperature must also be sufficiently high for this union to take place. It is therefore necessary that none of these conditions are lacking, in order that combustion shall occur. If any of these conditions be wanting, no combustion can take place.

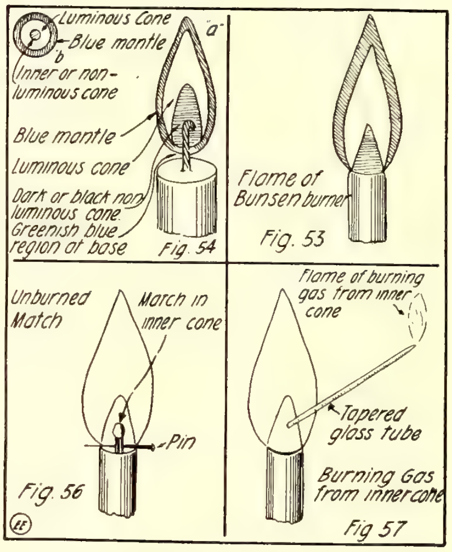
Thus, the combustion of coal is due to the oxygen of the air passing into a state of chemical union with the gaseous hydrocarbons of the coal, forming carbonic acid and water—vapor. Such chemical combinations are always accompanied by the production of more or less heat, as in the case of decaying wood and other vegetable matter. It is only when the action becomes so rapid as to cause the evolution of heat, accompanied by light, that the process is called burning or combustion.

In the above illustration, while the gaseous oxygen of the air has as much to do with the process as the more solid material [coal, wood, paper, cloth, etc.], the latter is alone termed the *Combustible* or *Burning Substance*, while the oxygen is termed the *Supporter of Combustion.*

From the foregoing we can now frame a definition as follows:—Combustion is a rapid chemical union accompanied by light and heat. Fire is a term nearly synonymous with combustion. Flame is not a substance, only a phenomenon accompanying such union.

A few substances burn at ordinary temperature, as for instance, phosphorous, which glows when exposed to the air. Generally substances such as paper, wood, coal, etc., require to be raised in temperature, or be set afire before they possess the power of uniting with the oxygen of the air. [The *Kindling Temperature,* which is taken up later.]

While the absolute amount of heat evolved during the combustion of any burning body is the same, yet the sensible heat may vary according to the rapidity of the process. For example, when phosphorous is exposed to the air at ordinary temperature, it combines very slowly with the oxygen, and gives out but little heat at any one moment, but is diffused over a great length of time. If the phosphorous is set on fire in the air, it burns vividly, and gives out much heat and light for a short time. Again, if the burning phosphorous is placed in pure oxygen, it enters into most vivid combustion, and evolves intense heat and a brilliant light for a still shorter period of time. In the latter instance the heat evolved at any one moment is greater, because it is more rapid, than that given off at the same time during the slower process of combustion. When permitted to proceed to a termination, there is as much heat produced during the whole time occupied in its development. The same remark applies to the coal placed in a furnace. So long as the door of the furnace is open, and there is little draft of air thru the fuel, a moderate amount of



Various Interesting Details of the Flame from a Bunsen Burner and a Candle.

heat is evolved, which may last for several hours. But when the door is shut, and much air is drawn thru the coal, the latter is more quickly burned and more heat is evolved during the shorter period of time than before. In the long run there is the same amount of heat evolved.

FLAME

A Flame is a particular form of combustion or burning. Ordinary combustion consists in the oxygen of the air combining with some combustible substance so rapidly as to give out light and heat. When the combustible is either originally a gas, or becomes so by the heat, the combination takes place in the form of flame. *Flame then, indicates the burning of a gas.* In most cases the gas of a flame is a compound of hydrogen and carbon, with minute particles of solid carbon suspended in it, and is formed from the fuel [coal, tallow, etc.] being decomposed by the heat. The heat and light of a flame vary with the gas; hydrogen produces great heat, but little light. The lighting powers of a gas depends upon the proportion of carbon it contains, the particles of which become glowing hot before being consumed. That carbon exists in a solid state in the white part of a flame is readily shown by holding a piece of glass into it [as done in Experiment No. 37, given in the March, 1917, issue of THE ELECTRICAL EXPERIMENTER] which becomes coated with carbon in the form of soot. No soot is deposited in the dark or non-conbustible area of the flame, because there the carbon is in chemical combination with hydrogen, forming a gas. The carbon becomes solid only when the hydrogen deserts it to unite with oxygen.

Gas or vapor is raised to so high a temperature that it becomes luminous; the higher the temperature and the denser the gas, the brighter the flame. This brightness may be increased by the presence of a third body, as when using a limelight.

We can form a definition as follows: Flame indicates the combustion of a gas.

Crabb [in Eng. Synon] determinates between flame, blaze, flash, flare and glare as follows:

"Flame signifies the luminous exhalation emitted from fire. Blaze signifies a flame blown up, that is an extended flame. Flash and flare, which are but variations of flame, denote different species of flame; the former a sudden flame, the second a dazzling, unsteady flame. Glare, which is a variation of glow, denotes a glowing, that is, a strong flame, that emits a strong light; a candle burns only by flame, paper commonly by a blaze, gunpowder by a flash, a torch by a flare, and a conflagration by a glare."

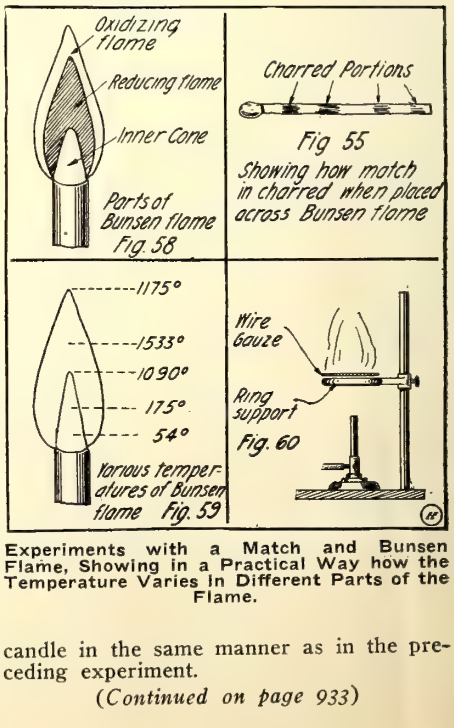
EXPERIMENT NO. 43

Examine the structure of a Bunsen burner flame, one in which the outlines of the inner parts can be clearly seen. Hold it in front of a dark object to bring out the parts more clearly. Also place it in sunlight, if possible, and let its shadow fall on a white paper. Take the lamp in the hand, and, looking straight down into the tube, note the outlines of the flame.

It will be noticed that there appear to be only two parts to the flame of the Bunsen burner (Fig. 53), the lower cone and the surrounding conical cap above.

EXPERIMENT NO. 44

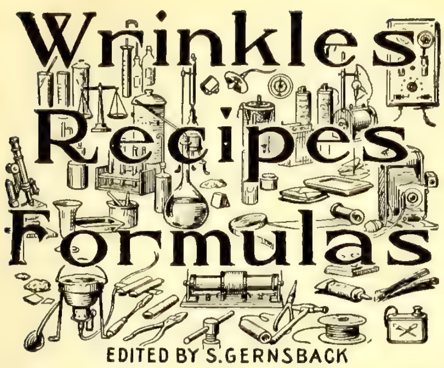
Examine the structure of the flame of a



Experiments with a Match and Bunsen Flame, Showing in a Practical Way how the Temperature Varies in Different Parts of the Flame.

candle in the same manner as in the preceding experiment.

(*Continued on page 933*)



Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

INTERESTING CHEMICAL EXPERIMENTS.

The Fiery Fountain: If twenty grains of phosphorous, cut very small, and mixed with forty grains of powder of zinc, be put into four drachms of water, and two drachms of concentrated sulfuric acid be added thereto, bubbles of inflamed phosphorated hydrogen gas will quickly cover the whole surface of the fluid in succession, forming a real *fountain of fire*.

Ghastly Pleasure Party: Dissolve common salt in an infusion of saffron and spirits of wine. Dip some tow in this solution and set fire to it, after extinguishing all other lights in the room. The ghastly effect produced on the faces of all present is very startling.

Tree of Crystals: Put a small quantity of bruised gum benzoin on a piece of thin metal or a saucer; invert over it a tumbler glass, in which place a sprig of wood, or any small-leaved plant, and apply the flame of a candle underneath, so as to melt the gum; dense fumes will soon begin to arise, and deposit themselves in most beautiful crystals of silky texture, on the sprig of wood, in delicate soft flakes, resembling foliage.

Contributed by H. FRANK.

SILVER PLATE.

Dissolve in silver nitrate ($AgNO_3$) enough ammonium chlorid (NH_4Cl) to bring about percipitation; cream to a light paste by adding cream of tartar ($HKC_4H_4O_6$). A little of this paste rubbed briskly on clean metal with a soft cloth will give the desired effect.

Contributed by A. H. DREESNER.

CHEMICAL LANDSCAPES.

These are drawn partly in India ink and partly in sympathetic inks, which are only visible when gently heated. The picture represents ordinarily a winter scene, but when heated the sky becomes blue, the leaves green and flowers and fruit are seen. The materials are as follows: Green, chlorid of nickel; blue, pure chlorid or acetate of cobalt; brown, bromid of copper. If the picture is too highly heated it will not again fade.

Contributed by H. FRANK.

HOW TO COUNT PAPER SHEETS RAPIDLY.

I give below a formula for the rapid counting of paper sheets. I have used this method and find it to be very accurate:

First, the thickness of one sheet of paper is measured in thousandths of an inch with a micrometer, then measure the total thickness of the sheets of paper to be counted. The total thickness is divided by the thickness of one sheet.

Contributed by HOBSON ARNOLD.

HANDY PRINTING AND DARK ROOM LIGHT.

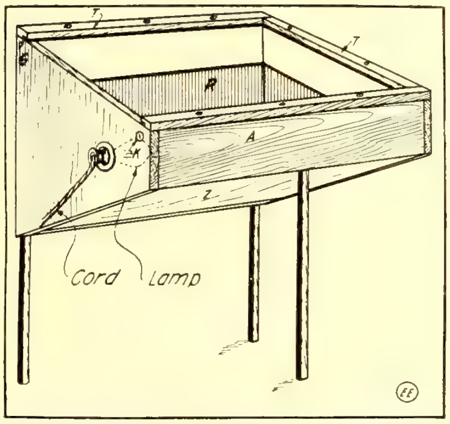
The ordinary light used in a photographic dark room has several disadvantages, namely: it does not allow one to print by the same light and when used as a dark room lamp does not throw the necessary illumination on the developing trays.

This one, however, has neither of the above objections in the idea outlined here as will be seen from diagram. The top, which works in groove G, has either a wooden frame holding a piece of red glass or red celluloid. A handle may be fastened to the red glass by a compound such as given in the February issue of THE ELECTRICAL EXPERIMENTER. The front piece A is pivoted on screws K, at end of the frame. By pulling out the lower edge, the sheet of ground glass R, between the printing frame and lamp may then be inserted after the bulb has been screwed into socket.

When printing, the slide of red glass on top is closed and the printing frame placed on top with light turned on; the negative or paper can be seen by placing them so that the light will shine thru them.

All corners and edges of the case should be made light-tight. Z is a sheet of red glass thru which the developing light falls. The glass may be either held in small grooves rabbeted in or by small grooved moldings.

Contributed by WARD H. INGERSOLL.



Home-made Electric Printing and Dark Room Lamp Combined, Which Will Prove Extremely Useful to the Amateur Photographer.

TO MAKE SOLIDS FROM LIQUIDS.

The spectacle of changing liquids into solids is at once both beautiful and mystifying.

Pour a concentrated solution of water glass (sodium silicate) into a glass and add enough hydrochloric acid to make the solution acid. The solution will turn into a solid resembling an opal and if the dish is inverted, will not fall out.

Dissolve a lump of alum in water and add enough ammonia water so that the solution smells strongly of it. Shake the mixture and it will turn into a thick transparent jelly.

Contributed by NATHAN N. WOLPERT.

FORMULA FOR GUM THAT U.S. USES.

Dissolve 2 ounces of dextrin in 5 ounces of water and 1 ounce of acetic acid and 1 ounce of Spirit of Wine.

To Protect Polished Steel or Iron from Rust: Go over the surface with paraffin, or steep the iron for a few moments in a solution of soda acidulated with muriatic acid. The result is a blue-black coating, not affected by air or water.

ANENT THE MAKING OF STORAGE BATTERY PLATES.

I have just finished reading in the February issue an article by Mr. B. Francis Dashiell, entitled, "Construction of a 6-Volt, 25 A.H. Storage Battery."

Surely, Mr. Dashiell, has not been forming storage battery plates with a paste made of dilute sulfuric acid and lead oxid, either red or yellow, or he would not be advancing that formula. I agree with you that this is not the first time that this method has frequently appeared in print, but it is practically impossible to build a storage battery that is highly efficient in this manner.

The following, tho considered a trade secret, is a method used by all battery repairmen, and I will guarantee good results if the directions are properly followed:

Take red lead 90%, sulfate of ammonia 10%, by weight; mix well, breaking up all lumps or crystals. Make into a thick paste with 26° ammonia. Make no more than what can be applied in two or three minutes. Apply with a wooden paddle to the *positive* plates. Place the pasted plates between sheets of blotting paper, and weigh heavily for twenty minutes in order to remove all surplus moisture. When removing the blotting paper, be careful that the paste is not removed also. Now place the plates in the sunlight, and allow to dry for twenty-four hours.

The same procedure should be followed with the *negative* plates, but using yellow lead oxid 94%, and ammonium sulfate 6%, by weight, and making a paste with 26° ammonia, 85%, and glycerine 15%, by weight.

After drying in the sun, and removing all surplus paste, the *positive* plates are ready for sulfating. This is accomplished by making a solution of sulfuric acid 14%, and water 86%. The positive plates are dipt into this solution, one at a time, withdrawn, and after three or four seconds, again dipt. This is repeated three or four times, and the plates finally left in the solution for eighteen to twenty hours; no more. The plates are then washed in several changes of water for two or three hours. The negative plates do not need sulfating, as they are hard enough without it.

The plates are now placed in the battery box before the electrolyte is added, and connected to the charging source. Electrolyte is added and the battery charged slowly. If the battery is charged and discharged slowly several times, plates removed and washed, and new electrolyte used, the life of the battery will be greatly lengthened.

Contributed by GEORGE FAY.

(Mr. Fay is correct. A similar formula given by him was used for years by the Editor, while he was engaged in the manufacture of storage batteries. He publisht this formula several years ago in his former magazine, "Modern Electrics" (July, 1909, issue).

Mr. Dashiell's formula is a very old one and good results can be had if one is careful and experienced. Mr. Fay's formula, however, is the better.—Editor.)

"CONDENSED MILK" AS A CEMENT.

Condensed milk applied to the edges of the pieces of a broken piece of china will keep the article as intact as the majority of *Cements* on the market to-day.

The writer has mended saucers that have withstood washings in hot water. He has also mended a cracked telescope lens of fairly large size with this unique cement.

Contributed by EDWIN W. ELY.

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month **$3.00** prize for the best photo. Make your description brief and use only one side of the sheet. Address the Editor, "With the Amateurs" Dept.

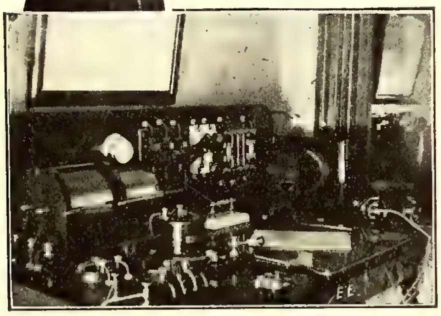
AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.
This month's prize-winner.

HUGH RENZO'S RADIO STATION.

I present herewith photo of my wireless station and of myself. My radio set consists of the following instruments, which are all clearly shown in the photo:

The Particularly Well Arranged Radio Amateur Station Owned and Operated by Mr. Hugh Renzo, of Paterson, N.J. A Typical High Class Amateur Lay-out.



Receiving:—"Electro" "Professional" loose coupler, one pair of "Electro" 3,000 ohm "Government" phones, "Electro" loading coil, one Murdock variable condenser, an "Electro" Junior fixt condenser for 'phones, and an ordinary mineral detector in which I use galena. With these instruments, in connection with my aerial which I describe below, it is possible for me to receive messages very clearly from the Arlington radio station and other government stations. In favorable weather I often receive messages without lifting the phones from the table.

Transmitting:—The transmitting instruments consist of a ½ k.w. Packard closed core transformer, line protector and kick-back preventer, 4-point switch for supplying current to connections on transformer, oscillation transformer, open spark gap and extra heavy key, all of which are connected to an "Electro" antenna switch.

Aerial:—The aerial used with the above instruments is made up of five strands No. 14 copper wire, spaced two feet apart with Electrose ball insulators at both ends. Total length of aerial is 63 feet, 25 feet high at one end and 52 feet at the other. The lead-in is connected inverted "L" style to a 100 ampere S.P.D.T. switch, which enables me to ground the aerial when not in use.

All instruments, both receiving and sending, are arranged on a table about 30"x50" in such a manner as to allow a space in the center for a piece of plate glass on which to transcribe messages.

Altho I have not interested myself sufficiently to apply for a license, I have adopted the call "OV" and will be very glad to converse with all nearby amateurs.

HUGH RENZO.
Paterson, N.J.

RENSSELAER POLY INSTITUTE WINS RADIO PLANT.

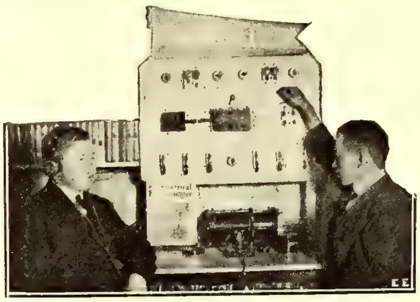
It has been announced by President Palmer Cricketts that $11,000 had been donated to the Rensselaer Polytechnic Institute by Washington A. Roebling, '57; Charles G. Roebling, '71, and John A. Roebling, '88, for the construction of a wireless station to be used in undergraduate and graduate courses and for purposes of research.

Washington Roebling is the builder of the famous Brooklyn Bridge and Charles Roebling is the president of the John A. Roebling's Sons Company of Trenton, N.J., manufacturers of wire rope. The erection of a station with which it is expected that communication may be had with any wireless station on this continent will start immediately.

A WIRELESS ECHO FROM COLUMBUS, OHIO.

Our receiving set consists of a home-made loose coupler, 5,000 meter loading coil, Murdock 43 plate variable condenser, tubular fixt condenser, Crystaloi detector and 2,000 ohm receivers. We can hear NAA, very plainly at noon and 8:55 at night; also, many other stations.

HENRY AND ANDREW KALPPNER, JR.
Columbus, Ohio.



Experimental Radio Station Operated Jointly by Henry and Andrew Kalppner, Jr., of Columbus, Ohio.

Gongs will not awaken deaf mutes in case of fire, so one institution has installed a fire alarm system for flashing electric lights in the sleeping rooms at night.

A CALIFORNIA AMATEUR.

The accompanying photograph shows my station, 6QL. I use a ½-inch spark coil with a Blitzen electrolytic interrupter, Leyden jar and helix for the sending set.

For receiving purposes I use a large capacity loading coil, loose-coupler, variable condenser, galena detector and 3,000 ohm 'phones.

I have obtained splendid results with this set, having received VAE, a commercial station in Canada.

NORMAN RICHARDS.
San Jose, California.

Norman Richards of San Jose, Calif., and His Neat Radio Transmitting and Receiving Apparatus.

Has your station photo appeared in "The Electrical Experimenter"? Why not purchase the electrotype and have some "real" stationery printed with your station picture on it? All of the "regular radio-bugs" are doing it.

THE VOICE OF THE WIRELESS.

By J. Walter Briggs.

The wild wind sings, my aerial rings,
  The storm clouds rush and roll,
The stars have gone and the moon ere long
  Will be hid—hear the bell-buoy toll;
No fear of the blast as it rushes past
  Fills my heart, for 'tis strong and brave,
And I'll do my work and never shirk
  As long as there's men to save.

Oh, the steady whirr and the giant purr
  Of the dynamo sends the fire,
A rushing test as the key is prest,
  Thru my nerves of trembling wire;
With a crackling snap the great spark-gap
  Springs to life in a burst of flame,
And I'll do my best if an S.O.S.
  Comes staggering in thru the rain.

But when sun is bright and the breezes light,
  Thru the pleasant summer days,
My hours are filled with a happier thrill,
  And no thots of a watery grave;
I say good-bye to ships that lie
  Far out in the ocean's foam,
Just a last farewell, like a broken spell,
  From the folks you left at home.

But what of the man who can understand
  And master my mighty power?
Give him the praise that's due the brave,
  Sing it every day and hour;
Without his plans to guide my hand
  I would lie in a useless heap,
My electric flood, like sluggish blood,
  Would clot, and I'd fall asleep.

But I quickly wake and like a snake
  My zig-zag sparks fly wide.
I brave the deep and the pathless steep,
  When my master's by my side;
I fear no foe, thru the space I go,
  At the tempest I loudly laugh,
Man's master mind has conquered time,
  With the WIRELESS TELEGRAPH.

HERTZIAN WIRELESS CLUB OF NEW YORK CITY.

Herewith is a photograph of the officers of the Hertzian Wireless Club, which has been in existence for some time. The following members were elected as officers at the last meeting (meetings being held every Saturday evening): Honorary member, Mr. Milton L. Frank; chief operator, Mr. S. Schmeltzer; assistant operator, Mr. J. Grossman; secretary, Mr. L. Wallerstein; treasurer, Mr. M. Mogy; editor, Mr. I. Sternberg; chairman of experiments, Mr. J. Hoffman; assistant chairman of experiments, Mr. B. Katzman; stationary inspector, Mr. L. Goldberg; chemical expert, Mr. A. Kamhi; sergeant at arms, Mr. I. Campus.

This club has won second prize in the "Round Up" popularity contest. The members are now building instruments at the club's central station, many of whom are members of the "Radio League of America."

Members of the "Hertzian Wireless Club" of New York City, which Won the Second Prize in the "Round-Up" Popularity Contest.

RADIO OPERATORS—ATTENTION!

The examination of applicants for radio operators' licenses will be discontinued at the Brooklyn Navy Yard and Fort Wood, Bedloe's Island, until further notice.

After February twelfth all examinations for radio operators will be held in the office of the Chief Radio Inspector, 603 Custom House, New York City, every day at 10:00 a.m. to 2:00 p.m., except Saturdays, Sundays and holidays.

All necessary forms will be furnished and filled out at the time of the examination. The papers will be marked and licenses issued as soon after the examination as possible.

RADIO CARRIES 11,500 MILES.

A wireless telegraph distance record of 11,500 miles was establisht by the steamer *Sonoma*, which pickt up messages from Eilvese, Germany, when two days off Australia, according to Royden Thomberg and Clio Bowers, operators on the *Sonoma*.

RADIO STATION OF ROBERT W. ROSS, JR.

My wireless station consists of the following: The receiving set, which is on an entirely separate table from my sending outfit, incudes a 1,500 meter loose-coupler a detector of the cat-whisker type, both of which are of my own construction and which may be seen in the photo at the extreme left. My laboratory has telephone equipment also.

I also have a loading inductance, which is connected between the aerial and the balance of the instruments, a regular loading coil (12-inch tuner used as a loading coil). I have a rotary variable condenser, a fixt condenser and a pair of Brandes' 2,000 ohm 'phones.

Robert W. Ross, Jr., Is a Member of the "Radio League of America" and an Enthusiastic Radio Experimenter Altho Young in Years.

For sending I have a 1½-inch spark coil, a small copper wire helix and a key with fairly heavy contacts, which is mounted on the table with the receiving set. There is a 40-foot, 5-wire aerial with 1½ feet spacing, elevated 40 feet from the ground.

With this apparatus I have heard a good many commercial stations, and numerous Amateurs, and I can send from 8 to 10 miles. I use the house current, together with a step-down transformer for sending. I am a member of the *Radio League of America.*

ROBERT WILSON ROSS, JR.
Philadelphia, Pa.

Amateur News

The Triangle Experimental and Research Laboratories Sighs Long and Deep.

In the February issue of the "EE" an article in a corner of the "Amateur News" Department called attention to the fact that the hard-working "Radio-bug," J. L. Cermak, E.E., has been guilty of establishing a laboratory for the use of the members of the Yorkville Radio Development Association and for the benefit of all outside radio-bugs who are not fortunate enough to be members. A very small charge is made for the work done for non-members.

Now, since that article was publisht, we have had a solid month of answering queries, designing sets, et cetera and, believe us, it is a wonder that those human encyclopedias—Messrs. H. Gernsback and Associates—are not on the roll of honor of the Asylum for Over-worked Radio Men and Retired Ether-Hounds.

Alas! We have had a taste of what mental damage a frenzied "radio-hound" can do when he runs wild. As soon as that article appeared in old reliable "EE," questions, proposals, etc., came pouring into our letter-box. Well, "EE" (God bless it anyway), is responsible for this. The directors of the laboratory asked Mr. Cermak to become the laboratory head. Mr. Cermak refused, and asked that his assistant, Mr. F. Smith, be appointed in his stead. This was done. Monsieur Cermak is frequently seen in company with a charming blonde, and it is thought that this may have something to do with his refusal to become the laboratory head.

Now, "bugs," if you have a question to ask (not if you have "EE" at hand always) or a "kick" to give, don't be bashful, send it. Come on, "radio hounds," do your worst; we're used to it now. Here is the address of our kennel. Triangle Experimental Laboratories, 73 East End Avenue, New York City.

The Colorado Springs High School Electric-Radio Club.

The wireless enthusiasts of this high school have succeeded in organizing a Radio Club of fifty members. The organization has had its club room and the funds for the buying of instruments contributed by the school board. This organization was formed for the purpose not only of studying wireless telegraphy and telephony, but also of studying high-frequency currents and other interesting electrical subjects. The members are chasing knowledge at a high speed and will have a complete set of high grade instruments to help on their quest very soon.

The officers elected were:—Samuel Garth, President; Paul Mechling, Vice-President; William Greenlee, Secretary-Treasurer; Julius Oberndorfer, Librarian; and C. E. Colburn was elected as an honorary member. For further information write Shadrack Franklin, 1130 N. Cascade Avenue, Colorado Springs, Colo.

Experimental Radio Club of Philadelphia, Pa.

The Experimental Radio Club of Philadelphia, Pa., was successfully organized on January 5, 1917, thru the efforts of Messrs. Crippen and Holloway.

The club includes among its members a number of young colored men interested in wireless, tho it has a membership now of only seven.

A course of instruction in the radio art, sufficiently broad enough to enable the graduate to secure an Amateur First Grade License, will be given by Messrs. Crippen and Holloway. Mr. Crippen, who is the President of the Club, holds an Amateur First Grade License and his call is 3 JI.

Besides Wilbert W. Crippen, President, the club has elected R. Marshall, Secretary and Treasurer. All interested should communicate with Messrs. Crippen and Holloway, 2038 Turner Street, Philadelphia, Pa.

The New Haven Radio Association.

The New Haven Radio Association, at its recent annual election of officers on January second, elected the following members to office:—President, W. F. C. Hertz; Vice-President, R. Merwin; Secretary, R. H. Campbell; Treas., A. P. Seeley.

The club has been meeting every Tuesday evening at the club room in the Y.M.C.A. Building. Since last spring, when the club was started, the membership has increased to twenty-two members. Communication should be addrest to the Secretary, 365 Edgewood Avenue, New Haven, Conn.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur News" Section, The Electrical Experimenter, 233 Fulton St., New York City.

Amateurs of Portland, Ore., Organize Radio Association.

At a meeting held at 325 Morgan Building on December 15, 1916, the Amateurs of Portland organized an Association to be known as the *Northwest Audion Association.* A constitution had been drawn up previously by a Committee and was read and accepted. The purpose of the Association is to advance and develop the art of Radio, and give to those who wish it, a chance to go deeper into the subject. Dues were fixt at $0.25 per month. Any person holding a Government License or who is interested in the art is eligible for membership, not only in Oregon but in the Northwest. Officers were elected for one year. Following is a list of officers for the year 1917:—President, C. L. Austin; 1st Vice-President, E. W. Berk; 2nd Vice-President, J. M. Hurtt; Secretary, P. W. Dann; Treasurer, R. T. Galyean; Sergeant-at-Arms, B. W. Montgomery; Chief Inspector, C. L. Austin.

Any persons or clubs wishing to communicate with the Association may do so thru the Secretary, P. W. Dann, 6315 Sixty-third Ave., S.E., Portland, Ore.

The Lowell Radio Club.

The Lowell Radio Club was organized Saturday, January 6, 1917, at the home of Everett E. Taylor, 156 Winthrop Avenue, Lowell, Mass. The meeting was well attended and the officers elected were:—President, Everett E. Taylor; Vice-President, Wilder A. Fernold; Secretary, William H. Carney; Treasurer, Caleb F. Rogers; Associate Directors, Charles H. McMaster; David H. Hanson; Warren R. Entwistle; Elmer A. Scott; and Franklin S. Coppen.

The club was organized to meet the needs of the rapidly increasing number of amateurs in Lowell, who hitherto have not been represented by an organization and so have not been able to secure the proper recognition.

The progressive plans of the club have aroused an enthusiastic spirit among its members, which argues well for its future success. Correspondence with other clubs is invited and all interested should address the Secretary, Lowell Radio Club, Lowell, Mass.

OFFICIAL LIST LICENSED RADIO AMATEURS NOT TO APPEAR UNTIL NEXT ANNUAL GOVERNMENT CALL BOOK.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of August, 1916. (Continued)

SIXTH DISTRICT—(Cont'd.)

Call Signal	Owner of station	Location of station.	Power kilowatts.
6AFD	Manasse, Gerald H.	102 Union St., Napa, Cal.	.5
6MH	Mills, Herbert R.	1721 Brush St., Oakland, Cal.	.5
6SZ	Palmtag, Lloyd A.	316 E. 3d St., Watsonville, Cal.	1
6RY	Ridderhof David	122 Witmer St., Los Angeles, Cal.	1
6FD	Roebuck, Fred	601 N. 2d Ave., Phoenix, Ariz.	1
6KR	Roitsch, Geo. A.	950 Olive Ave., Coronado, Cal.	.5
	Sacred Heart College	San Francisco. *See* Bernard F. McNamee	
6RS	Seares, Richard	351 Palmetto Drive, Pasadena, Cal.	.5
6AN	Seeberger, Samuel H.	5990 Canning St., Oakland, Cal.	.5
6QJ	Shannon, Thomas J. P.	1148 5th St., Santa Monica, Cal.	1
6ADC	Shiner, Gerald E.	126 S. Philadelphia St., Anaheim, Cal.	.5
6JB	Tassey, Glenn J.	1080 E. 3d St., Pomona, Cal.	.5
6FT	Terman, Frederick E.	Stanford University, Cal.	.5
6ACE	Trout, Delbert C.	506 Palm Ave., Burbank, Cal.	.5
6KY	Weidner, Arthur C.	3 30th St., San Francisco, Cal.	.5
6ADF	Youngstrom, Chas. H.	Ontario, Cal.	1

SEVENTH DISTRICT

Call Signal	Owner of station	Location of station.	Power kilowatts.
7AO	Carpenter, Charles B.	300 Oak St., Pullman, Wash.	.5
7AL	Creeden, James	Getchell, Wash.	.5
7AN	Hessey, Randolph	1223 South G St., Tacoma, Wash.	.5
7AW	Kessler, Chas. W.	348 24th Ave., Seattle, Wash.	.5
7AA	Motz, Wm. H.	4608 South J St., Tacoma, Wash.	.5
7AQ	Straney, Orral J.	R. F. D., Albany, Oreg.	1
7AM	Vance, Harold C.	Pullman, Wash.	.5
7AR	Van Inderstine, Furness	107 E. Washington St., Lewistown, Mont.	.5

EIGHTH DISTRICT

Call Signal	Owner of station	Location of station.	Power kilowatts.
8AIK	Addington, Charles A.	22 N. Market Space, Springfield, O.	.5
88BJ	Barnes, Vernon	Brecksville, O.	.5
AIX	Bruner, Clyde G.	1050 Grove St., Defiance, O.	.5
8JS	Cunningham, John P.	Bellefonte, Pa.	.5
8AJD	Darr, Clyde E.	125 Leverette St., Detroit, Mich.	.5
8AHI	Duerk, Karl	1000 Wilhelm St., Defiance, O.	.5
8IE	Finch, William G. H.	434 W. Court St., Cincinnati, O.	1
8AKI	Gravatt, Otis T.	Greenville, Pa.	.5
8AIO	Hildebrank, Almer M.	128 Atwood Ter., Bellevue, O.	1
8AKL	Hopkins, Waid	3125 Peach St., Erie, Pa.	.5
8AJW	Inskip, Leonard S.	514 Glenwood Ave., Buffalo, N. Y.	.5
8AKM	Miller, Adam R.	17 3d St., Greenville, Pa.	.5
8PS	Peterson, Edwin L.	1406 Arch St., Pittsburgh, Pa.	.5

EIGHTH DISTRICT—(Cont'd.)

Call Signal	Owner of Station.	Location of Station.	Power Kilowatts.
8AIW	Saunders, W. King	High School, Charlevoix, Mich.	.5
8AHR	Smart, John T.	233 S. High St., Marion, Ohio	1
8AJK	Stoeckel, Harold D.	2015 Bailey Ave., Buffalo, N. Y.	.5
8AJE	Taylor, Laurens A.	101 Lyceum St., Geneva, N. Y.	.5
8AHT	Thompson, R. R.	1462 Pennsylvania Ave., Detroit, Mich.	.5
8AIB	Warren, Edwin C.	Capac, Mich.	1
8AHM	Williams, Frank S.	790 Franklin Ave., Columbus, O.	1

NINTH DISTRICT

Call Signal	Owner of Station.	Location of Station.	Power Kilowatts.
9AGW	Andersen, Arthur C.	3518 22d Ave., S., Minneapolis, Minn.	.5
9SZ	Baker, Lyle D.	Forest City, Ia.	1
9TC	Baldwin, Kenneth D. H.	323 Moss Ave., Peoria, Ill.	.5
9QX	Blessman, Charles W.	1951 N. 27th St., Kansas City, Kan.	1
9HJ	Coleman, Winston	R. F. D. No. 7, Lexington, Ky.	1
9TI	Eisenhard, Geo. B.	Culver, Ind.	.5
9TZ	Gardner, John A.	Eureka, S. D.	1
9QK	Gjelhaug, John A.	Baudette, Minn.	1
9RN	Gleason, Francis C.	Gilman, Ill.	.5
9BR	Hefferman, Orin	1017 W. 5th St., Waterloo, Ia.	.5
9AB	Hill, James H.	1822 Darrow Ave., Evanston, Ill.	.5
9SX	Hutchinson, Maxwell W.	Middlebury, Ind.	.5
9TZ	Isaak, Edward R.	Eureka, S. D.	1
9SB	Johnson, Harold N.	311 E. Lincoln Highway, De Kalb, Ill.	.5
9RJ	Kamler, Ben R.	807 S. 18th St., St. Joseph, Mo.	.5
9SZ	Kibbee, George G.	Forest City, Ia. (Partner of Lyle D. Baker)	1
9GX	Kirbach, Carlton W.	2224 Gay St., Fort Wayne, Ind.	1
9RT	Kuzdas, Rudolph J.	1236 Ridgeland Ave., Berwyn, Ill.	.5
9TL	Longbrake, Forest	8600 Independence Ave., Shefield, Mo.	1
9QJ	Nowak, Ernest I.	2218 Francis St., St. Joseph, Mo.	1
9SC	Rawlings, Charles L.	522 N. West St., Lebanon, Ind.	.5
9QR	Romey, Paul K.	Columbia, Ind.	1
9QL	Shumate, Bayard	504 S. Lebanon St., Lebanon, Ind.	.5
9QT	Smith, Eddie	688 S. 39th St., Louisville, Ky.	.5
9TF	Spencer, Herbert H.	2149 Marshall Ave., St. Paul, Minn.	.5
9SY	Swain, Fred W., Jr.	3936 N. 22nd St., Omaha, Neb.	1
9AAS	Zehring, Laurence L.	410 W. Washington St., Bouffton, Ind.	.5

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of September, 1916.

FIRST DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
1NL	Ackerman, Henry J., Jr.	408 Mill St., New Bedford, Mass.	.5
1QV	Atkinson, Earl J.	137 Plunkett St., Pittsfield, Mass.	1
1NP	Barrett, Louis G.	38 Gilsum St., Keene, N. H.	.5
1HT	Bates, Lee A.	8 Moen St., Worcester, Mass.	.5
1CT	Bernstein, Nathan	74 Kingsdale St., Dorchester, Mass.	.5
1CV	Black, Donald W.	165 Trenton St., Melrose, Mass.	.5
1GJ	Butler, James B.	26 Burlington St., Woburn, Mass.	.5
1VX	Fabbri, Alessandro	Bar Harbor, Me.	.5
1WL	Gaillardet, Louis A.	248 Washington St., Weymouth, Mass.	.5
1QI	Garfield, Harold E.	129 Liberty Ave., Rockland, Mass.	.5
1QB	Harmon, Nathaniel P.	140 Burgess St., Manchester, N. H.	.5
1BS	Heath, Waldo S.	121 Rowley St., Winstead, Conn.	.5
1PU	Holbrook, Earle G.	13 N. Taunton Ave., Seekonk, Mass	.5
1BO	Johnson, Arthur	23 Harwood St., Lynn, Mass.	.5
1AK	Johnson, Carl E.	11a Edity Ave., Everett, Mass.	.5
1UG	Kuntz, Albert	Stamford, Conn.	.5
1QA	LaBree, Harold	2 Bryant Rd., Dexter, Me.	1
1MM	Leighton, Harold C.	24 Mudge St., Lynn, Mass.	.5
1BW	Lippincott, H. H.	West Chelmsford, Mass.	.5
1OG	McKee, Hugh W.	66 Burlington St., Woburn, Mass.	.5
1CW	McShane, Edward P.	13 Cottage St., Lewiston, Me.	.5
1CE	Marble, Harold E.	609 Pleasant St., Brockton, Mass.	.5
1UA	Merz, Arthur Frederick	185 Seymour St., Hartford, Conn.	.5
1BR	Parsons, George A.	Gloucester, Mass.	1
1VQ	Peabody, David	28 Lexington Ave., Greenwich, Conn.	.5
1ME	Priest, Walter F.	5 Oliver St., Everett, Mass.	.5
1PM	Randall, Eugene F.	27 Cotting St., Medford, Mass.	.5
1TM	Roberts, Wilfred V.	320 Point St., Providence, R. I.	.5
1DA	Stevens, Charles R.	133 W. Main St., Marlborough, Mass.	.5
1OE	Tarplin, Emanuel	325 Boston St., Lynn, Mass.	.5
1MJ	Tarylor, Ralph E.	249 Palmer St., New Bedford, Mass.	.5
1IQ	Twombly, Francis H.	57 Pleasant St., Framingham, Mass.	.5
1QC	Wheeler, James A.	321 Hanover St., Manchester, N.H.	.5

SECOND DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
2ATG	Baier, Elmer G.	444 7th Ave., Brooklyn, N. Y.	.5
2ATW	Carman, Harry H.	217 Bedell St., Freeport, N. Y.	1
2ATQ	Coddington, Wilbur E.	34 Crescent Pl., Middletown, N. Y.	.5
2ER	Daw, Edwin M.	7402 17th Ave., Brooklyn, N. Y.	.5
2FW	Ford, Fullerton	1202 Cortelyou Rd., Brooklyn, N.Y.	.5
2ATB	Hand, Francis E.	21 S. Kentucky Ave., Atlantic City, N. J.	.5
2ATY	Harring, Louis E.	Little River, N. J.	.5
2ATC	Harrison High School	Westchester, N. Y.	.5
2ATV	Herrmann, Edwin	Keansburg, N. J.	.5
2ABU	Hoffman, Karl	5 Summit Ave., Albany, N. Y.	.5
2ASZ	Howland, George A.	1001 5th Ave., Asbury Park, N. J.	.5
2ATP	Jacobs, Joseph	65 W. 127th St., New York, N. Y.	.5
2ATR	Klosner, Morris	2404 Crotona Ave., Bronx, N. Y.	.5
2ATS	Little, Harvey	1280 Asbury Ave., Asbury Park, N. J.	.5
2LU	Maurer, J. F., Jr.	682 Broadway, West New York, N. J.	.5
2ATN	Mayer, William G.	Long Branch, N. J.	1
2ATE	Mulcahy, William T.	3590 Park Ave., New York, N. Y.	.5
2ATA	Munroe, Kenneth H.	403 East Ave., Perth Amboy, N. J.	.5
2ATF	Penfield, Walker	Pelham, N. Y.	.5
2ATD	Pierson, Ronald P.	842 Lake St., Newark, N. J.	.5
2EW	Radio Club of Westchester	2320 Newbold Ave., New York, N. Y.	.5

SECOND DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
2ATZ	Taber, Raymond	17 N. Hamilton St., Poughkeepsie, N. Y.	.5
2ATO	Tilton, Ellsworth N.	1109 Dorchester Rd., Brooklyn, N. Y.	.5
2EO	Van Wickle, Charles F.	530 W. 174th St., New York, N. Y.	.5
2AUA	Warner, Edward T.	143 5th Ave., Roselle, N. J.	.5
2ATX	Wirth, Augustine	528 High St., Newark, N. J.	.5
2ATU	Woodruff, Kenneth R.	616 Clifton St., Athenia, N. J.	.5
2QM	Willis, Wm. S.	347 W. 14th St., New York, N. Y.	.5

THIRD DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
3FE	Angell, Otis P.	133 S. 49th St., Philadelphia, Pa.	.5
3FO	Bancroft, Ernest S.	Kennett Square, Pa.	.5
3CV	Burg, Edwin W.	910 10th St., N. E., Washington, D. C.	.5
3ES	Faulconer, Jack	2022 Columbia Rd., Washington, D. C.	.5
3AGO	Fretz, John C.	368 S. Olden Ave., Trenton, N. J.	.5
3ER	Glocker, Robert L.	4111 Belview Ave., Baltimore, Md.	.5
3DP	Hook, Ernest S.	3731 Reistertown Rd., Baltimore, Md.	.5
3AHW	Knight, Albert S.	520 N. 8th St., Richmond, Va.	.5
3BN	Maris, C. Emlen, Jr.	41 Owen St., Lansdowne, Pa.	.5
3BX	Sanders, William F.	732 Atlantic Ave., Collingswood, N. J.	.5

FOURTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
4BR	Boyett, Stephen L.	1047 Green St., West Tampa, Fla.	.5
4AR	Cole, Harry A.	335 Hill St., Atlanta, Ga.	1
4EI	Cooper, John C., Jr.	326 Market St., Jacksonville, Fla.	1
4EK	Geeslin, James W.	290 E. Linden St., Atlanta, Ga.	.5
4EL	Hyers, Thomas C.	805 Azeele St., Tampa, Fla.	.5
4EJ	Pittman, Robert F.	80 Windsor St., Atlanta, Ga.	.5
4EM	Wilkes, John M., Jr.	914 S. Rome St., Tampa, Fla.	.5
4BN	Gore, Calvin	819 Orange St., Wilmington, N. C.	.5
4EN	Short, Carl D.	122 Cole St., Macon Ga.	.5
4EO	Williamson, Robert E.	Tallulah Lodge, Ga.	.5

FIFTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
5BW	Cook, Paul S.	2911 Judson St., Shreveport, La.	.5
5AD	Smith, John D.	1316 Winston St., Shreveport, La.	1

SIXTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
6PW	Fisher, Fiacro J.	Coyote, Cal.	.5
6DW	Glesener, Walter W.	128 S. Grand St., Orange, Cal.	.5
6QL	Howard, Oliver M.	1703 White Ave., Fresno, Cal.	.5
6EL	Mundt, Edward L.	Alameda, Cal. (portable station)	.5
6TS	Thompson, Alan K.	1025 W. 72d St., Los Angeles, Cal.	.5
6KT	Vogler, June C.	Santa Clara, Cal.	1
6EV	Wathen, Edgar J.	1422 Wright St., Los Angeles, Cal.	.5

SEVENTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
7BB	Clark, Stanley A.	618 W. Pear St., Centralia, Wash.	.5
7AY	Craig, Dolph L.	1216 Court St., Salem, Oreg.	.5
7WD	Duncan, Willard	3922 Woodlawn Ave., Seattle, Wash	1
7BC	Ingebrigtsen, Lief	609 W. Market St., Aberdeen, Wash.	.5
7AX	Laughlin, George F.	Fairfax, Wash.	.5
7AZ	Robertson, Charles G.	277 N. Capitol St., Salem, Oreg.	.5

EIGHTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
8JC	Badina, Norman P.	170 E. Ferry St., Buffalo, N. Y.	.5
8ACG	Baer, Dana	833 Quincy Ave., Scranton, Pa.	.5
8RI	Burgie, John E.	Fillmore, N. Y.	.5
8OY	Farnyak, Carlton S.	Mansfield, O.	1

(To be continued)

THE "WIRELESS WIZ" AND THE CARD SHARKS.

(*Continued from page 885*)

were crowded, some badly bruised and disheveled, others snarling and glaring. Tables were overturned and broken; it looked as if a cyclone had just past over.

"You are trapt," the Captain's stentorian tones rang out, "make no resistance or it will fare ill with you," and one after the other the prisoners were brought forward, handcuffed and led to the waiting car. And thus ended the careers for a while of certain wise and crooked gamblers.

The "Wiz" hung around to get all the dope on the system they used and was surprised at its simplicity. Each watcher had a key, battery and induction coil. Wires were run down the walls and under the floor, making contact by means of small pins with wires running thru the table legs. Two small pointed contacts were fastened under the side of the table and by merely pressing his knee against these, the shark at the table closed the circuit. Every time the key was pressed he would receive a slight shock. A special system of signals were used to simplify the transmission of the information.

Joe Culver swore off gambling and was one of the main witnesses against the men, the "Wiz" being the other.

What puzzled me was where the "Wiz" had obtained the blowpipe, but it seems it was among the counterfeiters' belongings he had received.

I thot fame would make an egotist out of him, but he still rolls his own, lets his hands get dirty and to the best of my knowledge still wears the same size hat.

It took me a while to understand about the watch business, but it was also simple. The coil of wire around his waist was connected to the contacts on his glove. By holding the false watch so that one contact touched the case and the other the insulated stem, he had a circuit. The signals sent over the wires acted inductively on the coil and the faint buzz was heard when he apparently listened for the tick of the watch

"A telephone receiver is the most sensitive electrical detecting device, but I couldn't hold one to my ear in that room; hence the false watch" he explained, "and, Paul, the only game of chance worth playing is life," he finished with a smile.

THE EARLY DAYS OF RADIO IN AMERICA.

(*Continued from page 893*)

and connected in series with a pair of head 'phones and a potentiometer controlled battery.

During the year 1902, the output of radio literature increased in a very helpful degree. In its February, 1902, issue *McClure's Magazine* published a long article entitled "Marconi's Achievement: Telegraphing Across the Ocean Without Wires."

The Scientific American of February fifteenth, contained an article written by A. F. Collins, entitled "How to Construct An Efficient Wireless Telegraph Apparatus at Small Cost." I think it is safe to say that the appearance of this article did more to introduce the art of *amateur radio* than anything else that had appeared.

On April twelfth, the *Western Electrician,* of Chicago, published a communication from Dr. Lee de Forest with the heading: "An Interesting Sensitive Flame Experiment," which subsequently I could not help believing started the train of thought which culminated in the development of the marvelous AUDION.

The *Electrical World* of April twelfth contained a long communication signed by Wilfrid Blaydes, which shed considerable light upon the Marconi-Slaby controversy which was then raging in Europe.

In 1902, copies of three books on wireless telegraphy reached this country from England; one written by Richard Kerr, one by George de Tunzelman and Sir Oliver Lodge's "Signaling Thru Space Without Wires."

The first United States Government pamphlet on wireless appeared in 1903, entitled "Instructions For the Use of Wireless Telegraph Apparatus" by Lieutenant Hodgins, U.S.N. This booklet described only the Slaby-Arco *coherer* system. In fact none of these works described anything *beyond* the coherer.

Dr. John Stone Stone took out seventy American radio patents between 1901 and 1904, and Harry Shoemaker forty patents between 1901 and 1905.

In the year 1903 the International Wireless Telegraph Company was formed in America to exploit Dolbear's claims and to push litigation first begun in March, 1901, against Marconi. The claims were based on Dolbear's patent of October, 1886.

In October, 1903, stations were established by the U. S. Signal Corps at Nome and St. Michael's, Alaska.

The summer and fall numbers of *Popular Science Monthly* contained a long article by Prof. J. A. Fleming on "Hertzian Wave Telegraphy." This was one of the best authoritative accounts of Marconi's work up to that time.

In 1903, the author wrote the first book length American treatise on the subject of wireless. The matter was published serially in the *Western Electrician,* Chicago.

In 1903, the Marconi Company opened stations at Chicago, and at Milwaukee. The first International Radio Convention was held in Berlin, Germany, during this year. The report of Mr. John I. Waterbury, one of the American delegates to the convention, appeared in the *North American Review* of November, 1903.

These brief memoranda may well be closed with the advent of the year 1904, as during that year Fessenden's electrolytic detector, de Forest's responder, Dunwoody's carborundum detector, and Marconi's magnetic detector, all made their appearances, furnishing the hungry amateur with a plethora of devices to displace the often blest filings coherer.

The year 1904 clearly marks the beginning of RADIO'S climb to the plane of practicability. On February twentieth of that year the Western Union Telegraph Company's tariff periodical, *The Journal of the Telegraph,* for the first time announced the acceptance of messages for ships at sea.

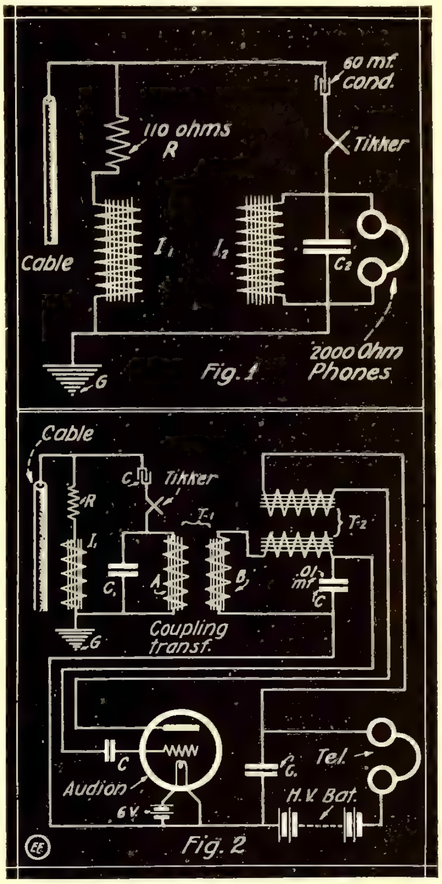
ONE DRY CELL NOW TELEGRAPHS ACROSS OCEAN.

A technical discovery expected to revolutionize ocean cable communication was recently announced by the U.S. War Department and described in a general way in the February issue of THE ELECTRICAL EXPERIMENTER.

The principal drawback to cable communication has been the necessity of employing the visual recorder, requiring the employment of highly trained cable readers. The new invention—the "Audion cable receiver"—is expected to do away with cable readers and bring the operation of ocean cables in line with land line and radio-telegraphy.

The preliminary experiments, which have been in progress for some months, were made at the Government radio laboratories, and the actual tests on an ocean cable have been completed recently. The improvement consists essentially in the adaption of the "tikker" and Audion types of instrument used for receiving the signals in radio-telegraphy which apparatus are connected up in the manner shown in the accompanying diagrams. At Fig. 1 is shown the simplest hook-up for the tikker as given to our readers by Dr. Louis Cohen, who was one of the experts engaged on the problem. He says that the current from a single dry cell (1.5 volts) would be sufficient to give good signals across the Atlantic cable, according to the tests conducted on an actual submarine cable. The incoming battery current (very weak of course) is past thru a resistance R, and inductance I_1, which circuit is shunted by an interrupter or *tikker,* in series with a 60 m.f. condenser and telephone circuit as seen at Fig. 1. The tikker causes the condenser C_2 to charge and discharge at a rapid rate thru the telephones. Thus the signal is made audible.

When necessary for long, high resistance cables, recourse is had to an Audion amplifier, Fig. 2. The tikker breaks up the incoming cable signal and the audio frequency current in circuit "A," is transferred by the iron core coupling transformer T_1,



Methods of Connecting "Tikker" to Submarine Cable, With and Without Amplifier, for Reading Telegraph Code Signals by Sound.

to Audion circuit "B." Transformer T_2 couples the wing of the Audion for tuned signal work.

The tests have been made on the Government Signal Corps cable from Sitka, Alaska, to Seattle, Wash., and the receiving apparatus was installed in the Seattle office. This cable is 1,086 miles in length and has a K.R. approximately equivalent to one of the Atlantic cables.

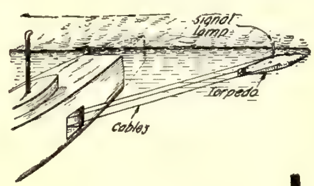
The actual receiver is an ordinary telephone. The feeble current received is normally inaudible in the telephone. It is broken up by means of a slipping contact "tikker" and rendered audible. In order to secure greater sensibility, a tuned Audion amplifier is used in connection with the tikker. The sensitiveness of this apparatus is so great that *less than one-twentieth* of the voltage necessary for operating the "siphon" recorder is sufficient to give good traffic signals.

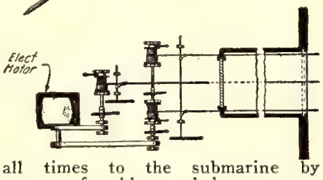
LATEST PATENTS

Positively Controlled Torpedo

(No. 1,212,468; issued to Alfred Extrand.)

A scheme providing for the positive control of a torpedo as seen, the torpedo hull being attached at



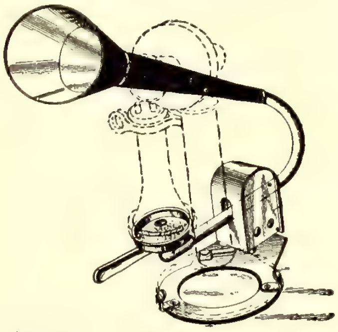


all times to the submarine by means of cables reeled up on or off of motor-driven drums, each drum having a control clutch of its own. Thus the torpedo (of the usual automobile type) can be accurately guided in its course. When the position of the torpedo is desired to be known it is possible to momentarily light an electric signal lamp on the torpedo which can only be seen from astern

Telephone Amplifier

(No. 1,212,785; issued to John L. McMillan.)

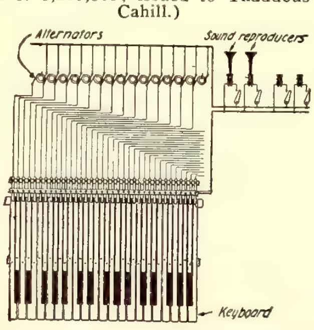
A novel idea in amplifying attachments for use on ordinary telephone, where the amplifier can be



instantly disconnected from the telephone proper and having no rigid connection with it. The invention comprises an amplifying horn so mounted as to be manually movable, first to contact with the ear-piece of the receiver as it hangs on the hook, and then by a continued movement to lift the receiver and permit upward movement of the hook, so that telephone is connected.

Electrical Distribution of Music

(No. 1,213,803; issued to Thaddeus Cahill.)

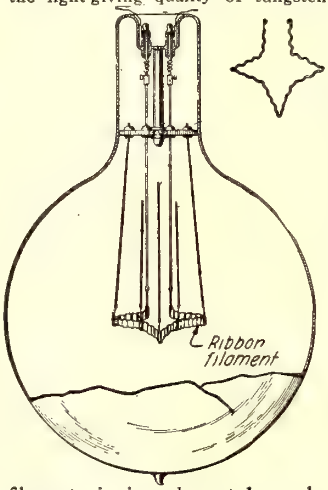


A remarkable exposition of an electrical music distributing scheme whereby a large number of small alternators are positively driven at varying speeds by suitable gearing to motors. The various alternators produce currents having frequencies corresponding to the vibrations of consecutive notes of the chromatic scale. A keyboard similar to that of a pianoforte or organ enables the circuits from one or more alternators to be closed, thus delivering one or more musical note-sounds to the outgoing line (which may be many miles long) and to which sound translating devices, such as telephone receivers with horns, are connected.

Ribbon Filament Lamp

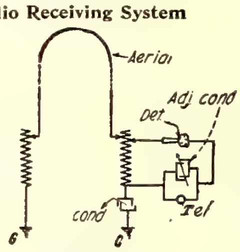
(No. 1,206,333; issued to F. G. Keyes.)

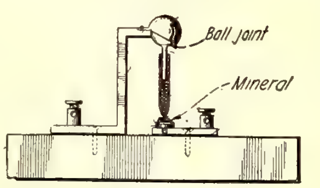
The patentee discloses in this invention a scheme for increasing the light-giving quality of tungsten



filaments in incandescent lamps by forming the filament into crimped ribbons. The ribbons may be mounted in various designs such as in the form of a star, etc. The inventor claims that by such construction he makes possible increased illumination from the filament with the same expenditure of energy as in other lamps.

Radio Receiving System





(No. 1,213,250; issued to G. W. Pickard.)

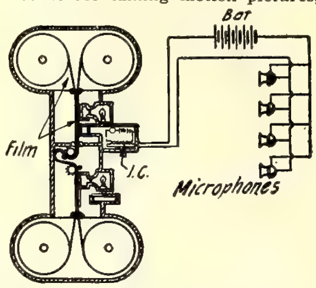
This patent covers the use of the well-known loop form of wave-interceptor, together with suitable tuning inductances and variable condensers as seen. The detector circuit comprises an adjustable condenser, shunted by telephones, with a rectifying mineral detector in series as indicated.

The detector here covered is of simple design, comprising a ball and socket adjustment for the movable contact resting on the mineral (such as silicon), which is held in an alloy fused into a brass cup.

Magnetic Sound Recorder for Talking Movies

(No. 1,213,150; issued to Henry C. Bullis.)

A method of producing sound records for talking motion pictures,

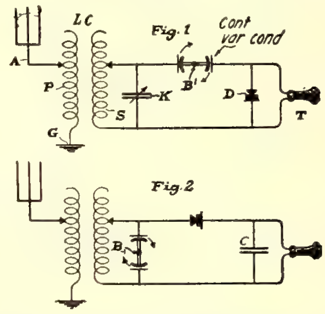


which consists essentially in photographically producing a positive negative master record of sound controlled light flashes. Microphones pick up the sounds and by means of an induction coil IC, the sound controlled currents are caused to influence a source of light acting on a sensitized film. The master negative is printed on a sensitized film containing finely divided metallic material in suspension. Subsequently all of the sensitized coating not hardened by printing the master negative on the sensitized film is removed.

Undamped Wave Receiver

(No. 1,211,963; issued to John A. Proctor.)

An ingenious method of receiv-

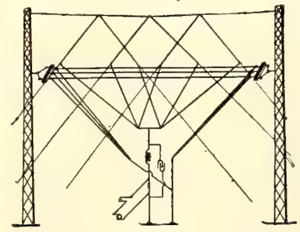


ing undamped wave radio signals with a simple form of circuit comprising a detector D, telephones T, loose coupler, tuning condenser such as K (Fig. 1), and a continuously variable condenser B^1. The latter has a rotating electrode run at from 200 to 500 times a second, to thus vary the capacity smoothly from zero to maximum, and to produce a corresponding sinusoidal note in the telephones T.

This invention causes the variation of the oscillations of the current delivered to the detector to be smooth and sinusoidal.

Radio Antenna

(No. 1,214,283; issue to Lee de Forest.)

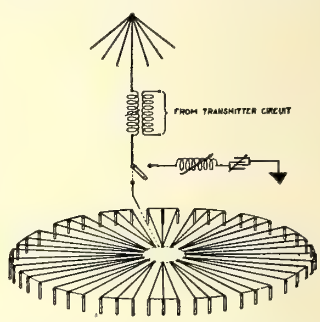


Relates to improved radio antenna design whereby it is possible to increase the capacity of the antenna and simultaneously diminish its radiation resistance, without entailing costly alterations or radical changes in design. This invention provides for an auxiliary earthed-antenna system erected in suitable proximity to and in electrical relation with the main radiating antenna whereby the patentee claims that "a genuine and very marked increase in the energy drawn from the source of supply is obtained and radiated as useful energy."

Antenna for Radiotelegraphy

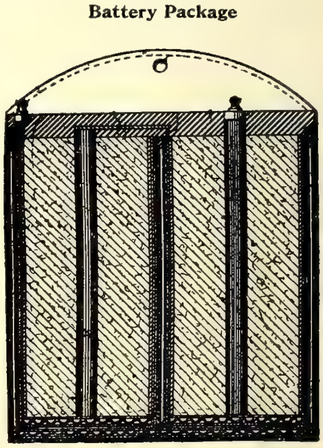
(No. 1,214,591; issued to Gustav Reuthe.)

Unique system for nullifying the effect of atmospheric electricity at high power, long range stations. The high vertical antenna is connected to a portion of the low horizontal antennae as a counterpoise,



while transmitting. When receiving the low horizontal antennae are connected to the receiving instruments, while the high vertical aerial is earthed thru a suitable inductance and capacity so that it can be detuned. By this means the vertical aerial absorbs most of the atmospheric "strays," besides acting as a Faraday cage or "screen" for the low receiving antennae. This arrangement is very desirable as low antennae, owing to their small height and strong damping, are unsuited for radiating energy, while the opposite holds true for high vertical antennae, especially of the umbrella type, in this particular case.

Battery Package



(No. 1,214,836; issued to John Smith.)

This invention relates to a dry cell battery package designed to provide a combined dry cell set and container which shall be both waterproof and heat insulating. Also to provide a battery set and package which may be hung on a nail. The usual zinc bottom is substituted by a waterproof, heat insulating base. The battery may comprise two or more cells, and is sealed at the top by sealing compound.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c EACH

Phoney Patents

Under this heading are publisht electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

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PHONEY PATENT OFFIZZ

No. $\sqrt{\frac{C}{E.R}}$

WILL U. CHEESIT of OBE CITY, U. X.
REDUCING APPARATUS

Spessonification of Patent Fettors **Patent Applicated**

To Whom You All is Concerned:

Be it beknowed to all Bipeds in this country and abroad, and particularly to all fat individuals, fat heads, fat alists, fatlings, as well as fatties that I, Will. U. Cheesit of Obe City, in the county of Fatuity, in the State of Utter Xostion have gradually and painfully invented an apparatus of widespread interest to all Humanity at large.

It is well known to phsychologists and alienists that there is nothing so effective to reduce superflous ombumpoint of stoutish individuals than strenuous exercise, especially marathoning. It is also well known since the earliest days of civilization that fat folks do not like to run far on account of them becoming rapidly heated up while running. The Latin term for this peculiar phenomenon is known to Doctors as *eshofé*, which in our language means *givemairboys*. My stupendous invention overcomes this trouble readily as will be seen. Furthermore while running a fat individual gives up 23,658,979¾ calories of useful heat for every mile covered. This vast amount of energy has gone to seed heretobefore and it is the purpose of my basic discovery to utilize such vast energy for commercial purposes.

Having thus explained the purpose of my invention, I will now describe its most valient as well as vital points.

The victim to be reduced is made to hoof it rapidly on endless rubber belt 3, revolving on its axis supported by bismuth casting 5. On the axis is also mounted a noiseless pewter gear 4 which thru flexible soft rubber transmissions 2, runs the speedometer 7 and cyclometer 1 indicating and recording the speed and distance covered. Attached to the main axle is also a green silk rubberized belt 9 which connects with fan 8 which has two *ice* blades in order to continuously cool the victim. The blades revolve so fast that they have no time to melt.

Hidden from the victim and attached to the main axle is a secret belt 6 made of chameleon skin for purpose of invisibility. This belt runs around the frosted glass pulley 10 which in turn is connected to a hydraulically prest, noiseless cheese pinion 11. The transmission in turn drives the 22 kilowatt purple dynamo 12 which thru the pale yellow switchboard 13, charges the pink storage batteries 14.

Having thus described from now on until all times my far reaching invention:

WHAT I CLAIM IS:

1° A reducing machine which while reducing collects all expended and expanded energy.

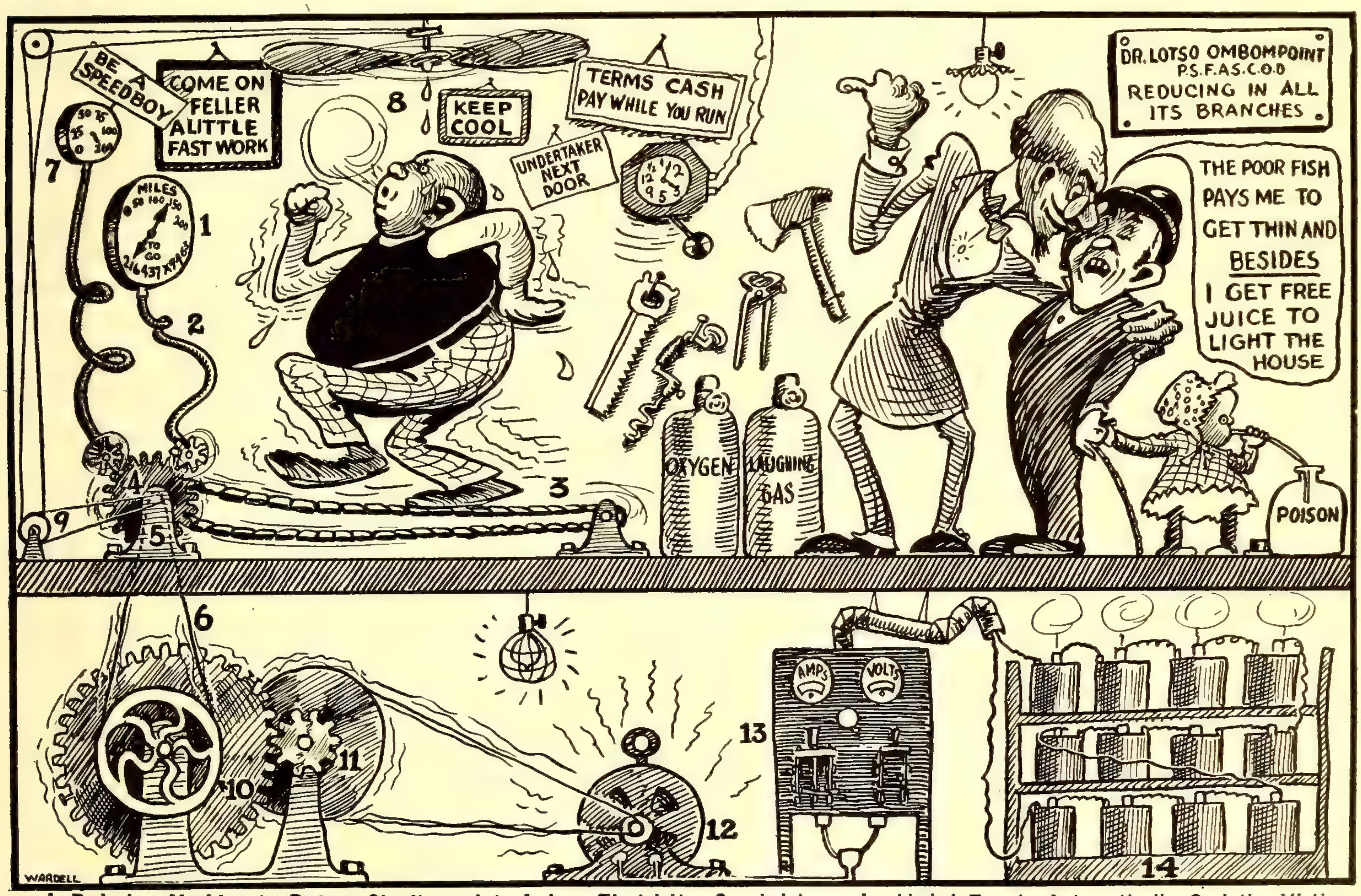
2° A reducing machine coupled to an ice-bladed fan to automatically cool the prime mover.

3° A reducing machine to reduce obesity and to induce electricity.

In commemoration thereof, I have emplaced hereunder and below my solemn chirograph and seal on this very day of February thirty-first, anno domino the nineteenth, at 5 o'clock tea, with a compound wavelength of 820° specific gravity under a barometric pressure of 1¼% Centigrade in the shade of Hades.

WILL U. CHEESIT,
By his Attorney,
J. C. McNamara,
4741 Indiana Ave.,
Chicago, Ill.

Witnesses:
H. O. Tomalé
U. Sedit.
May Onaise.



....A Reducing Machine to Reduce Obesity and to Induce Electricity, Coupled to an Ice-bladed Fan to Automatically Cool the Victim.

QUESTION BOX

This department is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

LOUD SPEAKING TELEPHONE

(740.) E. P. Smith, Marysville, Ohio, writes us:

Q. 1. "I have seen demonstrators in various store windows, using a telephone transmitter to speak into, wired to a megaphone with a loud-speaking receiver on the outside of the window. The demonstrator seems to speak to the people on the outside in an ordinary tone of voice, which can be plainly understood. Please give diagram of this outfit.

Circuits of Loud-Speaking Telephone, Comprising a Microphone and Special Low-Resistance Receiver.

A. 1. The system used by such demonstrators is a loud-speaking telephone consisting of a special microphone connected to a low resistance telephone receiver which has about 5 ohms resistance, equipt with a metallic horn. Diagram of connections is given herewith.

RADIO QUERY.

(741.) H. G. Wilson, New Zealand, says:

Q. 1. "In the Telefunken system, the alternator frequency is 500 cycles, which gives a spark frequency of 1,000 in the H. F. circuits. The spark gaps break down at 1,000 volts. Using say, 60 gaps in series, is it possible to get one spark per half cycle with a transformer secondary voltage of only 30,000 volts?"

A. 1. It will be possible, providing that the oscillatory circuit is tuned to the condition desired. In this case it will be necessary to employ a considerable amount of inductance. Great care should be taken in adjusting the gaps in order to operate satisfactorily in conjunction with the above-mentioned voltage, and a small amount of condenser capacity.

Q. 2. Would it not be necessary to have a secondary voltage of 60,000 volts in the case cited?

A. 2. Not necessary. However, for better spark gap operating conditions 60,000 volts will be found to give superior results. When employing 60,000 volts it should be remembered that the condenser capacity must be changed in order to obtain the desired effect.

Q. 3. What books do you recomemnd to a person interested in the practical construction of a wireless station?

A. 3. There are several good books publisht on the practical construction of wireless stations, namely, "Wireless Telegraph Construction for Amateurs," by Morgan, $1.50; "Experimental Wireless Stations," by Philip Edelman; Zenneck's "Wireless Telegraphy," $4.00; "Wireless Course," by Gernsback, Lescarboura and Secor, and numerous others, all of which can be obtained from our "Book Department."

POWER FACTOR.

(742.) William Maufras, Mantua Station, Ohio, wants to know:

Q. 1. What is the *Power Factor* and how can it be found by switchboard measuring instruments?

A. 1. There are several ways of defining the power factor, but the following is the simplest, namely: the power factor is the number of *true* watts indicated by a wattmeter, divided by the *apparent* watts, the latter being the watts as measured by an ammeter and voltmeter.

$$\text{Power Factor} = \frac{\text{true power}}{\text{apparent power}}$$

It can be measured by the employment of a wattmeter, ammeter and voltmeter and using the above expression, or else it can be found directly by using a *power factor meter.*

Q. 2. Can a 2,300 voltmeter for alternating currents be had? If so, where can I obtain one; if not, how can the voltage of such a line be found?

A. 2. A 2,300 volt A. C. meter can be obtained from the Weston Electrical Instrument Works, Newark, N.J.

If you have a low volt scale A. C. voltmeter you may utilize it effectively as follows: Procure a step-down potential transformer having a primary rating of 2,300 volts and a secondary delivering an e.m.f. in the neighborhood of that corresponding to the voltmeter scale. The ratio of transformation should be accurately known in any case for such procedure. It is dependent upon the ratio of the secondary turns to the primary turns.

TO OUR FRIENDS.

Do you realize that not one day passes when we do not receive from 150 to 250 or more letters addrest to the "Question Box"? If we were to publish all the questions and their answers we would require a monthly magazine five or six times the size of The Electrical Experimenter with no other matter but questions and answers! Of late the influx of letters has become so heavy that several of our associates have been forced to discontinue important editorial work in order to answer the mail. This we are certain you do not wish. You do not want your magazine to lower its present high standard. You want the best, the very best, and you know we never have failed you yet.

Moreover the multitude of letters are wholly unnecessary. Most of the questions we are asked every day have been answered before in the Question Box. Therefore ere you sit down to write to us, look over your back numbers and nine times out of ten you will find the answer.

We strive hard to publish only such matter as has not appeared before in our columns, and for that reason only a small fraction of queries of those received by us are actually publisht.

Kindly note, therefore, that in the future we cannot, in your own interest, answer questions by mail, free of charge.

For questions requiring immediate answer our fee is 25c. for the first ordinary question and 25c. for each additional question. We will gladly advise fee for special questions entailing considerable calculations or research. Stamped and addrest envelope should be enclosed with the queries and, moreover, any sketches accompanying them should be made on separate sheets. And please be brief.

THE EDITORS.

FASTEST TELEGRAPH OPERATORS.

(743.) Robert Willig, San Angelo, Tex., asks the name of the three fastest telegraph operators in the United States:

A. 1. The three fastest telegraph operators in the United States are the following: William Gibson, L. M. Clifford and T. S. Brickhouse.

RHEOSTAT.

(744.) Warren L. Bald, New York, N.Y., asks:

Q. 1. Will the sketch of bottle I submit do for construction of a water rheostat to carry current of 110 volts, 50 amperes, in order to heat up the grafite-carbon-steel junction shown herewith?

A. 1. The container is far too small to carry the above current. A chamber at least two feet in diameter and two to three feet high, will be required. The electrodes should be made of iron and properly supported.

Q. 2. What degree of heat would you say will be created by the apparatus as constructed in drawing, with the current mentioned above?

A. 2. With the above device and a current of 50 amperes a temperature of 1,800 degrees Fahrenheit can be obtained. However, it is impossible to give the exact figure, as this depends upon the size of the grafite and the gas-carbon rods, also upon their quality of hardness. A soft grade of carbon will produce a greater amount of heat per unit current than the harder variety carbon. Certain factors must be considered in this problem in order to determine exactly the intensity of heat generated by your device.

Compound Joint of Steel-Carbon-Grafite, Which, the Querist Desires to Heat Up Electrically.

(Continued on page 917)

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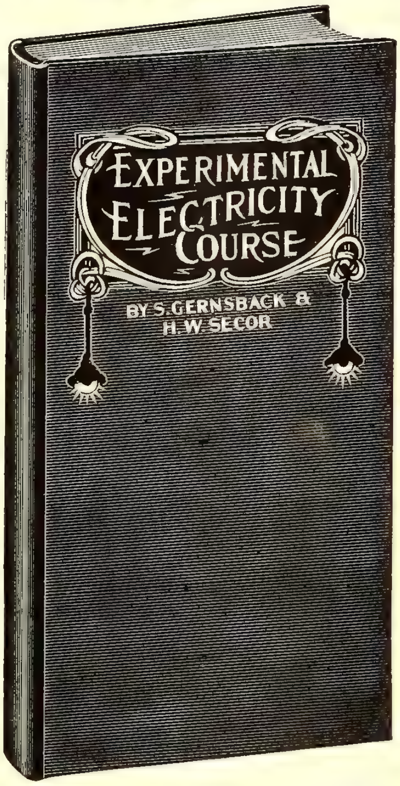

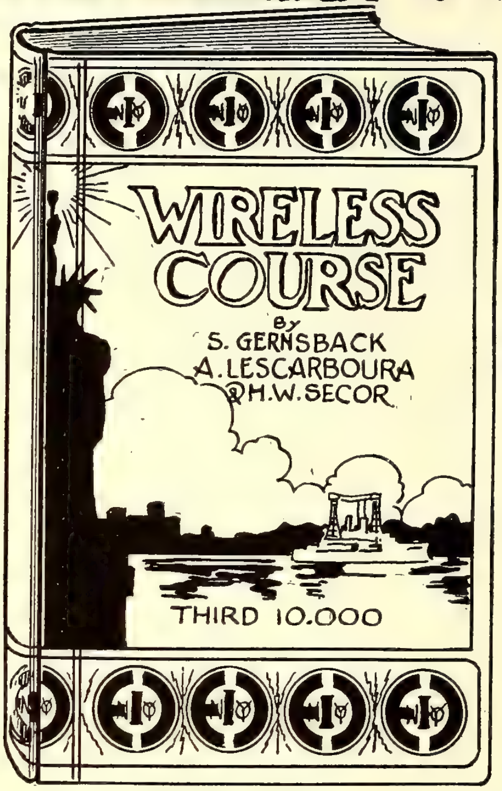

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Gentlemen:

Please enter my subscription to THE ELECTRICAL EXPERIMENTER for the term of......year. for which I enclose herewith $.................

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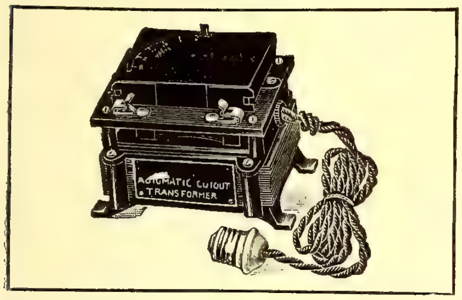
A UNIQUE AUTOMATIC CUT-OUT STEP-DOWN TRANSFORMER.

The A.C. step-down transformer illustrated is equipt with an automatic cut-out device of a new type, which shuts off the current when an overload or short-circuit occurs. The manufacturer claims that it is possible to reset the circuit-breaker while normal load is on, but it is impossible to reset the circuit-breaker while over-load is on the transformer or if there be a short-circuit on the secondary. For example: Suppose that a boy is operating a train of cars, drawn by an electric locomotive, and in turning a curve one of the cars should jump the track and fall across the third rail and outside rail, thus causing a short-circuit. The automatic cut-out of the transformer will act and open the circuit. Now suppose further that this train of cars had been operating on 20 volts when the accident happened and befoı removing the car that is across the track, the boy attempts to turn the current on again. Just as soon as the rheostat handle reaches the first contact point, which is the five volt connection, the breaker opens again, and this will continue to occur until the cause is removed, when it will be found that the circuit-breaker or cut-out can be again reset and the train will operate properly.

To mention another feature of safety, which is claimed for this device: In the operation of toys, among the younger generation, the curiosity of seeing things run fast is characteristic of their age, regardless of what harm they may do to the apparatus under operation. For instance: A motor designed for 15 volts will frequently be run on 25 volts if that voltage is obtainable, just to see the motor speed up.



New Step-Down A. C. Transformer Fitted With Automatic Circuit-Breaker to Protect It From Short Circuits or Over-Loading.

It is not necessary to state what the motor will look like after such abuse. The new automatic cut-out transformer prevents any such excess voltage being applied, as with higher voltage, excess current is past into the motor and this current is invariably greater than the limit the circuit breaker is set for, with the result that the breaker operates and opens the circuit, thereby protecting itself and also the apparatus under operation.

A NICKEL FOR THIS "SPEAKING TUBE."

In the corridor of the Telephone Building on Bloomfield Avenue, Montclair, N.J., there are two unattended public telephone coin-boxes in booths, and the cashier in the Local Commercial office adjoining is frequently asked to make change for patrons. One morning I approached an apparently bewildered person at the counter, greeted him with the usual salutation, and asked what I could do for him, says a writer in *Telephone Review;* this was his reply:

"I wonder if you would be kind enough to give me three five-cent pieces and a ten-cent piece for this quarter, as I have a desire to talk thru that speaking tube outside there."

QUESTION BOX.

(*Continued from page 914*)

ELECTRICAL PROBLEM.

(745.) John Olson, Hartford, Conn., desires to know:

Q. 1. A certain problem which I wish to have solved is given herewith: When a certain dynamo is delivering no current, it takes 1¾ horse-power to drive it. When the generator delivers 150 amperes, it takes 25 horse-power to drive the machine. Calculate the electro-motive force of the dynamo on the assumption that all of the additional power required to drive is used to maintain the current of 150 amperes.

A. 1. The voltage of the generator is 115.7 volts.

Q.2 A 40-mile telegraph line is disconnected from the ground at both ends. The line is then connected to the ground at one end, thru a 220 volt battery and a direct-reading voltmeter resistance, of which is 16,000 ohms. The voltmeter has a maxi-mum scale deflection of 2.9 volts. the insulation resistance of the 40 and what is the insulation resistan mile of the line?

A. 2. The insulating resistanc 40-mile telegraph line is 1,197,0(while that of the one mile length times that, or 47,880,000 ohms.

Q. 3. What formula can be measuring the resistance of a wire temperature is considered?

A. 3. The equation for determi resistance of a wire and taking ac the temperature is as follows:

$$R_t = R_o\ (1+Bt)$$

WHERE:—R_t= resistance of the conductor at the temperature desired.

R.=resistance of wire at 0° C which can be obtained from any wire table.

B.=a constant and is called the temperature coefficient of resistance of the material composing the wire. This factor is also obtained from a wire table.

TRANSMITTING RANGE.

(746.) Hugh McNeigh, Memphis, Tenn., wishes to know:

Q. 1. What is the maximum transmitting range of the following set with an aerial of 4 to 6 wires—100 feet long, 75 feet high — 1 K.W transformer (flexible)—Sayville rotary gap; 1 K. W. high potential variable glass plate condenser; commercial oscillation transformer; precision hot wire meter and key?

A. 1. Under favorable weather conditions you should have no trouble in transmitting 100 miles with your transmitting outfit, providing, of course, that your oscillating circuit is properly adjusted so as to obtain maximum radiation, as noted on the hot wire ammeter.

Q. 2. I had a ¼-inch spark coil and connected one secondary to one terminal of a fancy geissler tube and put the other secondary as far away from tube as possible. I then turned the current on. A distinct gray glow in the tube was visible in the dark. I touched the unused terminal of tube and it (the tube) lit up as if the other secondary wire was being used. I found that I could attract the color by touching side of tube. What is the cause of this? I had four dry cells in the primary circuit of the coil.

A. 2. The phenomenon which you have experienced in conjunction with your geissler tube is that of the conduction of high tension electricity thru the body to the ground, which connects the negative terminal to the opposite terminal of the geissler tube, thus producing the effect you speak of.

(*Continued on page 919*)

TRADE-MARK
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REGISTERED

LENZITE CRYSTAL DETECTOR

Patented May 2nd, 1916

A first class Wireless Detector is half the battle in the wireless game. Have you tried the best and most effective, **The "Lenzite" Crystal Detector?**

Why Is Our Detector Near Perfection?

If you want to have a perfect receiving detector, try ours. If not satisfactory, return same within thirty days and we shall be pleased to refund you the price.

Being a user of an Audion Bulb and having firmly, after due test and consideration of "mineral detectors," discarded them as unstable and unreliable and very inconvenient, being hard to keep in adjustment, I was very skeptical as to Lenzite, but glad to make the test and more than pleased that I did so.

I found that the reception of signals with Lenzite as a detector quite beyond any hopes that I may have had.

e mineral in question (Lenzite) seems to be "sensitive" nearly all over its surface on all sides, which is a very great advantage as it makes it almost as easy to keep in adjustment as an audion, and brings in the signals, when proper attunement is accomplished, in a very loud and positive manner, and I must add I was greatly surprised as it, without any question, has given me far greater results than any other sort of mineral detector I have tried, and I have tried to get all that I have been able to hear of.

Its clear, loud, readable demonstrations should make it very desirable to operators whether or not they use audions, which consume power which Lenzite does not, and it is quite as good for long distance work as well. I shall be glad to tell others of it.

Very truly,

HERBERT W. BRISCOE.
(6 IH U. S. License.)

Send money order, express order or check for **$5.00** and we will send you, postage prepaid, one of our Lenzite wireless detectors.

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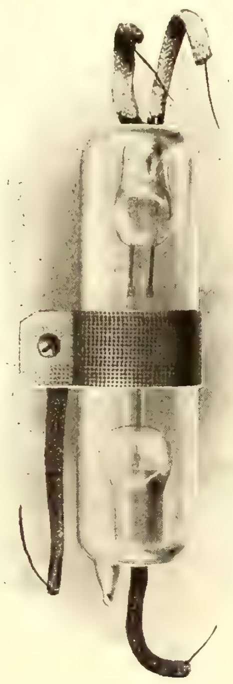
VACUUM TUBE DETECTORS



Notice to Our Customers

Have you received our new circulars containing our guarantees?

Is the tube you purchased from us giving you absolute satisfaction?

Remember we live up to our guarantees.

This detector does not employ or incorporate an evacuated vessel containing three electrodes, namely, a filament, a plate, and a grid disposed between the filament and plate.

DEALERS:--WE ARE STILL ON THE JOB

Write for Circulars

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534 Pacific Building **San Francisco, California**

QUESTION BOX.

(*Continued from page 917*)

RECTIFIER.

(747.) George L. Cowperthwait, Scranton, Pa., asks:

Q. 1. Is it possible for me to connect a rectifier on an A. C. circuit, so that I may use a D. C. fan motor? If not, is it possible for me to rewind my fan motor for an A. C. single phase 60 cycle circuit? If so, will you please give me an idea as to how this can be done?

A. 1. It is possible to employ a rectifier so as to convert the alternating into direct current in order to use it to run the direct current motor, providing that the motor is wound to the voltage received at the direct current mains of the rectifier. About 80 volts is usually obtained at the direct current mains.

Considerable amount of trouble will be experienced in rewinding a single phase A. C. motor. It is advisable for you to purchase a finished A. C. machine if you desire to run it direct on the line.

ELECTRICAL INSTRUMENT.

(748.) J. Thomas Johnson, Kern County, California, asks:

Q. 1. I would like to know if an electrical instrument has been invented for locating oil-bearing land or underground oil sands.

A. 1. As far as we know we have never heard or seen any instrument for locating oil-bearing land or underground oil sands.

Q. 2. Would it be within your province to give a description of the principle involved in a compass, as far as present knowledge permits?

A. 2. The general accepted theory of the compass is that of the attraction of *unlike* magnetic poles and the repulsion of *like* poles. Since the compass needle is merely a light, permanent steel magnet, pivoted on a point and acted upon by the earth's north and south magnetic poles, any variation in the earth's magnetic field is accurately shown by the movement of the compass needle. The north pole of the compass needle is really the *south* pole, since it is attracted by the earth's north magnetic pole, which as stated before is the attraction of opposite sign poles. Space does not permit us to go into further details on this subject; however, we would refer you to an excellent book on the subject by Silvanus P. Thompson entitled "Elementary Lessons in Magnetism and Electricity."

QUENCHED SPARK GAP.

(749.) Delbert Myers, Amboy, Ind., asks:

Q. 1. Must the spark chambers of a quenched gap be absolutely airtight?

A. 1. If most efficient results are to be obtained from a quenched spark gap, it is absolutely necessary to have the discharge chambers airtight; in fact it will be impossible to obtain proper quenching action of the gap if any air is present in the chamber.

Q. 2. Give the condenser capacity of the E. I. Co.'s 1 K. W. condenser for each variation, as there are four variations?

A. 2. The total capacity of the above make 1 K. W. condenser is .0203 m.f. The four sections are equally divided and each section has an electro-static capacity of .005+m.f.; the second variation is .010 m.f., the third .015 m.f., and the fourth .0203 m.f.

Q. 3. Please give the number of plates in each step?

A. 3. The first section is composed of four plates, while the other three sections are made up of five plates each.

This condenser is composed of the proper number of glass and metal plates, assembled en bloc and thoroly impregnated with a special sealing compound.

(*Continued on page 921*)

THE ORGANS OF ELECTRIC FISHES

An interesting contribution is given to *Science* by Mr. Elmer L. Shaffer, of Princeton University, on the subject of electric fishes. He says in part:

It was suggested to the writer by Professor U. Dahlgren, of Princeton University, that *Gymnotus carapus* might furnish material for the study of electric organs. Miss A. Lowrey (see *Jour. Morph.*, Vol. 24, p. 693) in her examination of several Gymnotid fishes was unable to find electric tissues. She found that

in or between the first and second muscular units of the ventral ortion of the great lateral muscles, there was a slight degeneration of parts of the muscles. The larger units had been reduced to two minute oval muscles embedded in either strands of cartilage, or strands of cartilage and fat, and occupied parts of two triangular spaces, one on each side of the median septum just above the (muscle) unit which controls the anal fin. No plates, special nerve fibers, or nerve endings were seen.

In my examination of the specimen which had been collected by Professor Dahlgren some years ago, I noticed that when the fish was scaled a portion of the body appeared almost translucent. The location of this part corresponds exactly to the location described by Miss Lowrey where "slight degeneration of parts of the muscles" had taken place. Sections were made of this portion of the body, and a study of these has shown beyond all doubt that the portion of the body in question is composed of electric tissue. Not only were the characteristic electroplaxes found, but also the special electric nerve fibers and blood-vessels supplying them.

The fish used for this study measured approximately 31 cm. in length. The body is more or less filiform, tapering to an extremely finely pointed tail. The head is flattened dorsally and the upper lip projects slightly over the lower lip. The gill opening is rather small with a dusky spot just above it. The vent opens just behind the throat. The dorsal fin is entirely lacking, while the ventral fin extends from the tip of the finely pointed tail to a position just posterior to the vent opening. The fin is controlled by a muscle unit lying just dorsal to it. The electric organs extend from the tip of the tail forward, following along the entire length of the ventral fin and lying dorsal to the muscle unit controlling the fin. There are two such organs, one on each side of the body, each tapering more or less at the cephalad and caudad ends, thus giving the organs the form of much-elongated spindles. In cross-section these electric areas appear triangular in shape and are separated by the median septum.

The electric spindles are divided into five longitudinal tiers by horizontal sheets of connective tissue running the entire length of the organ. In these tiers the electroplaxes are arranged perpendicular to the septa in compartments bounded by the electrolemma and embedded in the *electric jelly*. These compartments, with the electroplaxes lying in about the middle, are relatively large, with the result that the electroplaxes are rather widely separated. Since the strength of the electric current produced is proportional to the number of electroplaxes, it is safe to assume that the electric current produced by *G. carapus* must be extremely weak, if it is at all perceptible.

The electroplaxes are plainly seen in any section taken through the electric organ. They are more or less square or oblong in shape, with irregular projections (papillae) on the cephalad and caudad sides. These papillae are usually longer on the caudad sides. Numerous oval nuclei are arranged periferally and no cell walls are present. The core of the electroplax is homogeneous

(*Continued on page 922*)

QUESTION BOX.

(continued from page 919)

ARMATURE CORE CONSTRUCTION.

(750.) Paul Johnson, Philadelphia, Pa., writes us:

Q. 1. How is a built-up armature core constructed?

A. 1. They are made from ring sections stamped from sheet metal and are fastened to a central support or spider, which consists of an iron hub with radial spokes and a rim with provisions for fastening the rings. The rim of the spider is provided with dovetail notches into which fit similar shaped internal projections on the core segments. Each layer of the core frame is firmly held in place by end clamps. The manner of fastening the rings to the spider is an important point, for it must be done without reducing the effect of cross-section of the core, in order not to choke the magnetic flux.

Q. 2. What effect has the cross-magnetizing-force on the field of a motor?

A. 2. It tends to shift the field around in a direction opposite to that of the rotation.

Q. 3. Can you give me a concise explanation of the operation of a Thomson recording wattmeter?

A. 3. Before explaining the operation of the instrument, it should be remembered that it consists of four elements namely: (1) a motor causing rotation; (2) a dynamo providing the necessary load or drag; (3) a registering device, the function of which is to integrate the instantaneous values of the electrical energy to be measured and (4) means of regulation for light and full load. The construction of the armature and field is entirely different from that of the ordinary motor, inasmuch as no iron is used in its construction; therefore the torque of the armature is dependent upon the product of the field and armature strengths. The strength of the field, there being no iron, varies directly with the current in the field. Thus the strength of the field with 10 amperes flowing, is exactly twice the strength of the field with five amperes flowing. The strength of the armature is dependent on the voltage of the system to which it is connected, the armature element of the meter is practically a voltmeter. There is therefore a torque or pull varying directly with the strength of the armature and the field, or in other words varying directly with the watt load and except in so far as influenced by friction, the speed of rotation varies directly with the torque. The currents generated in the (drag) disc armature consist of eddy currents, which circulate within the mass of the disc.

TRANSFORMER.

(751.) Joseph Hans, Brooklyn, N.Y., desires:

Q. 1. What factors are to be considered in choosing between three phase and single phase transformers for three phase current transformation?

A. 1. No specific rule can be given regarding the selection of single or three phase transformers, since both designs are equally reliable; local conditions will generally determine which type is preferable. However, the following will be found to be helpful:

Single phase transformers are preferable where only one transformer group is installed and where the expense of a spare transformer would not be warranted. In such installations the burning out of one phase of a three phase unit, would cause considerable inconvenience for the reason that the whole transformer would neces-

sarily have to be disconnected from the circuit before repairs could be made.

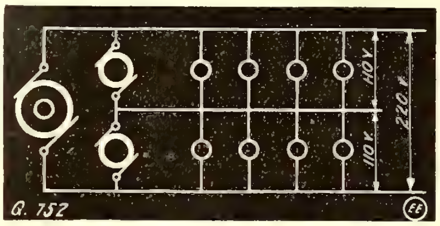
In employing three phase transformers, having both the primary and secondary connected in delta, trouble in one phase will not prevent the use of the other two phases in open delta. By short circuiting both primary and secondary of the defective phase, and cutting it out of the circuit, the magnetic flux in that section is entirely neutralized.

Q. 1. In water-cooled transformers how much cooling surface is required for an internal cooling coil?

A. 2. The surface of the cooling coil should be from one-half to 1.3 sq. in., per watt of total transformer loss, depending upon the amount of heat which the external surface of the transformer case will dissipate. For a water temperature rise of 43° Fahrenheit; 1/32 lb. of water per minute is required per kilowatt of load.

BALANCING SET.

(752.) Albert Haskell, Harrison, N.J., inquires:



How a Motor-Balancer Set Is Connected to Equalize the Voltage on Both Legs of a Three-Wire System.

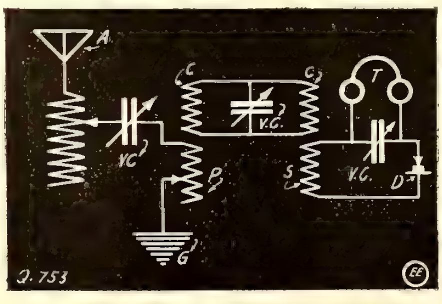
Q. 1. What does a balancing set consist of and how is it connected?

A. 1. A balancing set or balancer consists of a motor mechanically connected to a dynamo used to balance a three-wire system. The operation of such a combination is practically the same as a dynamotor and its connection is given.

When an unbalanced load comes on, the voltage on the lightly loaded side rises and on the heavily loaded side drops. The machine on the light side then takes power from the line and runs as a motor, driving the machine on the heavy side as a dynamo, supplying extra current for that side. This action tends to bring the voltage back to normal and provide good regulation.

Q. 2. How is balancing of a three-wire system accomplished?

A. 2. In practise it is impossible to obtain an exactly balanced system, as the turning on and off of lamps as required results in a preponderance of lamps in the upper or lower sets and furthermore even when the number of lamps in the two sets are equal, they may be located irregularly, thereby causing considerable currents to flow for short distances in the neutral line. Therefore, the larger the number of lamps in the circuit, the easier it will be to keep the system in a balanced condition.



Connections of Marconi Multiple Tuner With Tertiary "Energy Transfer" Circuit.

(*Continued on page 929*)

THE ORGANS OF ELECTRIC FISHES.

(*Continued from page 919*)

in appearance. The nerves and blood-vessels always approach the caudad side of the plates, a condition which is similar to that found in the electric eel and other Gymnotids.

It is thus evident that the tissue which Miss Lowrey has described as *degenerated muscle units* is really an electric organ. Her mention of "*strands of cartilage* being intermingled with the degenerated muscle leads me to believe that she has seen the electroplaxes and interpreted them as being cartilage. They are usually of a homogeneous, hyaline appearance and with their numerous nuclei might present a cartilaginous appearance. Yet their form is that so characteristic of electric plates that one can not overlook them.

Another of the Gymnotids which Miss Lowrey has examined and reported to possess no electric organs is *Eigenmannia virescens*. In the posthumous work of Sachs (1881) on *Gymnotus electricus*, some of his field notes are publisht which describe and figure portions of the body which he considered to be the electric organs of *Eigenmannia* (*Sternopygus*). It is interesting to note that his description of the macroscopic appearance of the electric organs exactly fits that of *Gymnotus carapus* presented here.

From an evolutionary standpoint the weak or pseudo-electric fishes form a subject of interesting speculation. The Gymnotids (except *Electrophorus electricus*, the electric eel) and certain of the Raiidæ possess these weak electric organs. Darwin, in his "Origin of Species" (page 167, sixth edition) has admitted that the electric organs of fishes present difficulties to his theory of natural selection. Are the weak electric organs *rudimentary*, or are they *new organs in the process of progressive development?* If they are rudimentary, why have they been discarded; if they are new organs just beginning to appear, of what selection value can they be if they produce no perceptible electric current? Only a study of the development of these organs can throw light on these questions. In certain of the Raiidæ which have been investigated it seems quite evident that the electric organs have been recently acquired and are not, therefore, the rudiments of previously existing well-developed ones.

PROFESSOR FLEMING ON LONG-DISTANCE TELEPHONY.

Prof. J. A. Fleming commenced his fifth lecture at the University College, London, on "Long-Distance Telephony" with a demonstration of the effect of loading upon the current sent into a 14-mile 44-lb. cable, and the current received at the far end. Artificial cables were employed and it was shown that on switching over from an unloaded to a loaded cable, the current at the sending end diminished but the received current very greatly increased. The high-frequency alternator used for the experiment did not yield a pure sine wave, but Prof. Fleming showed that the undesired components of the wave could be filtered out by connecting resonating circuits in shunt to the terminals, each such circuit containing a capacity and an inductance in series, such that the frequency with which it would resonate equalled $\frac{1}{2}\pi\sqrt{LC}$. By winding coils upon the inductance coils, as in a transformer, pure sinusoidal currents corresponding to the resonating harmonics could be obtained, having, for instance, frequencies of 1,000, 3,000 or 5,000 cycles per second respectively.

For the study of these high-frequency waves the Duddell oscillograph was not suitable, as its natural frequency of vibration was not sufficiently great—it should be ten times that of the wave under examination. The Braun cathode-ray oscillograph was free from this objection, but the trace obtained was not sharp enough. However, a rough practical test could be made with a condenser, voltmeter and ammeter; connecting these with the alternator, if no harmonics were present, the current I would be $= 2\pi\ n\ v\ c \times 10^{-6}$, or $10^6\ I/n\ v\ c = 2\pi = 6.28$, if, however, harmonics were present, the latter ratio would always be greater than 6.28, possibly two or three times as great. For a true sine wave it was best to use a special machine such as that designed by Mr. Duddell.

The measurement of the small alternating currents employed in telephony necessitated the construction of special instruments, usually dependent upon thermal effects. Methods of measuring small capacities were also explained. Remarking in connection with the measurement of s/c that the Postoffice engineers had discovered that gutta-percha conducted alternating currents better than direct current, Prof. Fleming described a special capacity bridge which he and his late assistant, Mr. G. B. Dyke (killed on active military service), had developed for the investigation of this effect, and showed the importance of the phenomenon in the cases of dry manila paper, gutta-percha and vulcanized rubber, all of which varied widely in conductivity for high-frequency alternating currents with the frequency and the temperature. For ordinary g.p. s/c = 100 or 120; for Siemens special g.p. s/c = 20 or 12. The value of R/L could be measured with the Hughes bridge, which the lecturer explained in detail.

SILVANUS P. THOMPSON MEMORIAL.

A fund is being raised in England to purchase the very valuable scientific library of the late Dr. Silvanus Thompson, who died June thirteenth last, and to present it to the British Institution of Electrical Engineers as a memorial of his life and work, the library to be accessible to the public on the same conditions as the Ronalds library.

THE WORK OF THE NAVAL CONSULTING BOARD.

The year has witnessed the perfecting of teamwork between the experts of the Navy and the outside scientific world, says Secretary of the Navy Daniels in his annual report. The Naval Consulting Board, headed by Thomas A. Edison, and composed of members selected by the leading scientific societies of the country, has rendered noteworthy service. The lack at first of any provision in law whereby the members of the board could be compensated for expenses incurred incident to their service, which they rendered willingly and with conspicuous generosity, has been remedied by the last naval act, which appropriated $25,000 for this purpose. Congress has thus been quick to secure for the Navy the aid of outside scientists, and the approbation of the President when he declared, in view of the Navy's need of preparedness, "not for war but for defense," personally to the members of the Naval Consulting Board that "We must have the cooperation of the best brains and knowledge of the country." Of the problems presented by the Navy Department for solution, some have been solved and others are in process of investigation, especially where the question involved is one subject to continuous improvement. Reports as to the value of many inventions have been received from the Naval Consulting Board, and its work has brought the officials of the Navy into closer touch with many industries.

A notable development of the board's work is its plan for the perfection of industrial preparedness thruout the country in its organization in each State of a committee, composed of one member each from the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Chemical Society, to work in connection with the committee on production, organization, manufacture, and standardization of the Naval Consulting Board. With five members in each State this committee, which is called the *committee on industrial preparedness,* consists of a total of 240 members. The District of Columbia and the Territory of Alaska also is represented on this committee. The members of this committee have been designated as State directors of the organization for industrial preparedness, and they are associate members of the Naval Consulting Board of the United States. The directors in each State have enlisted the services of all the members of the five societies named, who are designated as field aides, and who are earnestly and energetically assisting in gathering information collected in the form of an industrial inventory.

These blank inventories were sent confidentially thru the State directors and aides to manufacturing establishments of every character thruout the entire United States, and the information thus secured in answer to questions on the blanks has been confidentially filed for the use of the Government in time of national need or crisis. This information is of such a character as will allow munitions of war to be ordered and manufactured in the

most expeditious manner and delivered in the shortest possible time. The responses to these requests for industrial information have been exceedingly gratifying, and already they have received at the central office of the committee on industrial preparedness, New York City, 24,500 inventories, and it is expected that the total number will soon reach 25,000. This means that if it were ever necessary to mobilize to defend our country against foreign aggression, at least this number of concerns might, when prepared by this Government with proper gages and drawings, be counted on at short notice to transfer the energies and machinery of industrial peace into the manufacturing of munitions of war. In other words, it means that America can never be caught off her guard with an insufficient number of shells and cartridges and other implements of defense, as was the case with some of the countries of Europe at the beginning of the present conflict.

In connection with the organization of the Naval Consulting Board, Congress was asked to provide an experimental and research laboratory so as to utilize in the fullest degree the talent and genius of the civilian scientists who responded so generously to the request for their aid. The naval act of this year provides for such a laboratory by appropriating $1,500,000 for its construction. This laboratory will undertake the study of such subjects as gun erosion, torpedo motive power, the gyroscope, submarine guns, protection against submarines, torpedo and mine attack, improvement in submarine attachments, improvement and development in submarine defense, storage batteries and propulsion, aeroplanes and aircraft, improvement in radio installations, and other necessary work of this kind. The act establishing the laboratory authorizes the employment of such scientific civilian assistants as may be needed. This is a marked advance in naval development, and work done in this laboratory is expected to result in the greatest value to the Navy, especially in determining the value of new inventions, improving materials, bringing new materials into use, improving products, lessening weight, and materially decreasing the cost of operation on board ship.

DOES NEGATIVE SURFACE TENSION EXIST?

An interesting discussion on the phenomenon of negative surface tension is given by Arthur L. Kimball in *Science,* in respect to a previous note by Professor W. A. Patrick, who express doubt as to the existence of negative surface tension, suggesting that it can scarcely be conceived without assuming a force of repulsion instead of attraction between molecules of the liquid.

But he surely can not mean to question the existence of negative surface tension at a surface *between a liquid and solid,* says Mr. Kimball, for how otherwise are we to explain the most familiar facts in capillarity? Is it not negative surface tension which causes the water to rise in a capillary tube, or against a glass wall, and causes a drop of oil to expand indefinitely over a glass plate? Is it not the greater negative surface tension in the oil-glass surface which causes the film to expand against the contractile force, or positive surface tension of the oil-air surface?

Nor does it appear to be necessary to suppose a repulsive force between molecules of the liquid in order to account for the existence of such a negative tension, for if the resultant force of attraction on a particle of liquid near the surface, due to all particles on both sides of the surface

lying within the range of sensible molecular attraction is directed away from the surface and towards the interior of the liquid, the particle will tend toward the interior and we shall have positive surface tension, but if the resultant attraction is toward the surface there will be negative surface tension.

In case of an air-liquid surface the attraction of neighboring liquid particles upon a particle in the surface is so much greater than any opposing outward attraction by adjoining air molecules that the first condition holds and the surface tension is *positive.* While at a glass-oil surface a particle of liquid near the surface may be supposed to be more strongly attracted by the neighboring glass molecules than by the oil molecules in its vicinity, in which case the resultant attraction is toward the glass, the potential energy of a liquid particle is less at the surface than in the interior of the liquid, and the surface tension is *negative.*

When liquid comes against liquid the case is complicated by the mobility of particles on both sides of the boundary. It seems probable, however, taking an oil-water surface as an example, that if the resultant attraction on an oil molecule at the surface is directed across the boundary from the oil side toward the water, that a water molecule at the surface being in the same situation with respect to the surrounding molecules will be urged in the same direction. In other words, we can hardly imagine a particle of one sort in the surface as being drawn in one direction by the attraction of all the surrounding particles on both sides of the surface, while a similarly situated particle of the other sort would be drawn in the opposite direction.

We may assume then that at a surface between two liquids, particles on one side are urged away from the surface, while those on the other side are urged toward it. That is, there are two influences, one tending to contract the surface and the other to expand it. If the first is predominant there is positive surface tension; this is the ordinary case where diffusion does not take place, as with water-oil or water-mercury. If the second is predominant the surface tends to expand indefinitely, and the limit would seem to be reached only when one liquid is uniformly diffused thruout the other. In this case diffusion is to be expected also from the consideration that if particles in the one liquid are drawn so powerfully towards the other as to force the expansion of the second liquid in opposition to its contractile tendency, it seems probable that they will be drawn actually *into* the second liquid and thus the integrity of the surface be destroyed. We conclude, therefore, that *a positive surface tension is to be expected between all liquids that do not interdiffuse.*

If the particles in a colloid solution are to be regarded as solid, we may expect to find cases where the surface tension is positive and other cases where it is negative. Where it is positive there will be a tendency to flocculate, for as two colloid particles come together liquid particles move out from between them into the interior of the liquid and the capillary region surrounding the particles is thus decreased in volume and the potential energy of the system is diminished. When, on the other hand, the surface tension is negative at the surface of a colloid particle, there will be no flocculation, and the particles will not approach each other near enough to crowd the liquid out of the region of surface energy around either particle. This, of course, does not imply that there is any tendency in the latter case for the colloid particles to remain in equilibrium equally diffused thruout the liquid.

ELECTRICITY FOR OIL FIELDS.

Conditions in certain sections of the Oklahoma oil fields are to be revolutionized in the matter of power and light, according to the announcement of the Midco Gasoline Company, which is to invest $2,000,000 in the building of a power plant and many other improvements. The power plant will furnish electric power and light for the oil fields and will mean the substitution of motors for gas engines. The power plant is in the course of construction just south of Bartlesville, Okla.

SUNLIGHT AND THE MAGNETIC NEEDLE.

An interesting discussion on sunlight and the magnetic needle by F. C. Loring, department of terrestrial magnetism, Carnegie Institution, appears in a recent number of *Science*.

Mr. Loring says in part:—"The writer is directly interested in collecting ocean data on the nonmagnetic ship *Carnegie*, to be used, first, practically in constructing charts for navigation and, second, in theorizing on the causes of the earth's magnetism and on its changes. I desire to call attention to the work of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, D.C., in the making of extensive magnetic observations leading to the formation of some correct theory of the causes of the earth's magnetism.

"So far as I am aware neither Faraday in his experimental researches nor Maxwell in his mathematical treatment thereof, nor any one else recently, ever proposed or performed an experiment, excepting the experiments with polarized light, to show that a direct connection existed between light and magnetism.

"At the end of Faraday's first period of brilliant discoveries or about 1841 various investigators had performed many experiments with this end in view.

"In general these had taken the form of attempts to magnetize bodies by exposure in particular ways to different kinds of radiations; and a successful result had been more than once reported only to be proven in error on re-examination.

"Sir John Herschel was the first to indicate the true path of procedure. He wrote:

'Induction led me to conclude that a similar connection exists, and must turn up somehow or other, between the electric current and polarized light and that the plane of polarization would be deflected by magneto-electricity.'

"Faraday had already discovered the nature of this connection in 1834, but had considered his experiment a failure. In 1845 after Herschel's remark he varied the original experiment with success by placing a piece of heavy glass between the poles of an excited electro-magnet; and found that the plane of polarization of a beam of light was rotated when the beam past thru the bar of glass parallel to the magnetic lines of force composing the field. This constituted the discovery of the connection between light and magnetism.

"In 1851 Faraday wrote:

'It is not at all unlikely that if there be an *æther*, it should have other uses than simply the conveyance of radiation.'

"This sentence has been considered the origin of the electro-magnetic theory of light.

"The question which natural philosophers had never ceased to speculate on, that of the manner in which electric and magnetic influences are transmitted thru space, assumed a definite form about the middle of the Nineteenth Century and issued in a rational theory. It was at this point that the whole matter was taken up and eventually theoretically solved by Maxwell. He said:

'We can scarcely avoid the inference that light consists in the transverse undulations of the same medium which is the cause of electric and magnetic phenomena.'

"At the time Maxwell did not examine whether this relation was confirmed by experiment. For years the electro-magnetic theory was beset with difficulties and was unfavorably received by his most famous contemporaries. Helmholtz, after many years, accepted it, but Lord Kelvin, it seems, never did.

"It is quite interesting to note here that Lord Kelvin in 1904 admitted that a bar magnet rotating about an axis at right angles to its length is equivalent to a lamp emitting light of period equal to the period of rotation, giving his final judgment, however, that 'the so-called electro-magnetic theory of light has not helped us hitherto.'

"While pondering over the subject of terrestrial magnetism, electricity and magnetism on the night of Tuesday, March 7, 1916, the following thought came to me with such force that I set it down in my diary. A copy is as follows:

'I conceived the idea to try the effect of a concentrated sunlight on the magnetic needle or magnetized bar of any kind. The question being will not the concentrated light lessen or strengthen the magnetism of the magnet?'

"In performing such an experiment arrangement must be made so as to exclude the effects of the absorbed energy appearing as heat. I intended to try this as an experiment at some convenient time in the hopes that some new connection might be brought about concerning the subject of light, electricity and magnetism and their mode of propagation.

"On Saturday, March 11, 1916, four days afterwards, I chanced to see a newspaper clipping regarding some work of Professor T. J. J. See, of Mare Island, Cal. In this article Professor See proposed to explain many things, among them being 'the direct effect of sunlight on a magnetic needle, as in Nipher's experiment of 1913.' This was a complete surprise. Evidently this experiment had been tried with success by I suppose Francis E. Nipher, of Washington University, St. Louis, Mo.

"It seems to me that such an experiment would be valuable to science in many ways. The question arises as to the quantitative effect produced—if appreciable, then might we not expect or predict a change in all magnets more or less with time—especially as they are exposed to the sunlight? It is well known that magnets lose some of their magnetism during the process of aging. Might this effect be a contributing cause?

"The question as to the effect on small magnets such as in use for the determination of the earth's magnetic elements assumes some importance when considered in this regard.

"What might be the effect of the sunlight on the magnet if it were rotated about a horizontal line thru its center of mass and perpendicular to its magnetic axis? The theory of magnetization by rotation has been treated in two articles appearing recently in *Science* by Barnett.

"Aside from the foregoing it would be interesting to note the effect of *radioactive emanations* upon a magnetic needle.

"There are two well-known cases of the transformation of luminous into electrical energy, the *thermopile* and the *photo-electric cell.* However, in neither one is the transformation direct, as would be the case of *luminous energy falling upon the magnetic needle.*

"It would be interesting to see this matter investigated in the light of modern electrical theory and to know of Nipher's experiment and of the results obtained."

[We extend space in the columns of THE ELECTRICAL EXPERIMENTER to any investigator of standing who has discovered anything definite along these lines. Address all communications to the Editor.]

QUESTION BOX.

(*Continued from page 922*)

MULTIPLE TUNER.

(753.) John Fisher, Los Angeles, Calif., asks us for:

Q. 1. A diagram of connections for a Marconi multiple tuner.

A. 1. The appended diagram gives the connections of the tuner you speak of.

Q. 2. Is it possible to employ any magnetic substance in proximity to oscillating circuits as used in the undamped wave receiver?

A. 2. Not ordinarily. However, it was found that by employing three coils properly placed with a magnetic disc near by, the signal was considerably magnified. This has been developed by Mr. Ernest Mignon and his system was described at length in the March issue of this journal.

Q. 3. Where can I obtain information on the subject of wireless transmission of photographs?

A. 3. There has been publisht an excellent book describing this subject in non-technical language entitled: "Wireless Transmission of Photographs" by M. J. Martin. It can be supplied for one dollar by our "Book Department."

TRANSMISSION VOLTAGES.

(754.) Frederick Voughan, Memphis, Tenn., wants to know:

Q. 1. What are the standard voltages for alternating current transmission circuits?

A. 1. 6,600, 11,000, 22,000, 33,000, 44,000, 66,000, 88,000 volts. The amount of power to be transmitted determines, in a measure, the limit of line voltage. If the most economical voltage considered from the point of view of the line alone be somewhere in excess of 13,200 volts then step-up transformers must be employed, since the highest voltage for which standard alternators are made is 13,200 volts. In a given case the saving in conductors by using the higher voltage may be more than offset by the increased cost of transformers.

Q. 2. How are vector diagrams constructed for obtaining resultant pressures?

A. 2. On the principle of the parallelogram of forces.

Q. 3. Is it possible to change a three-phase current into a single phase?

A. 3. Yes; by the use of a phase changer.

TRANSFORMER QUERY.

(755.) Paul Motney, Little Rock, Kans., asks:

Q. 1. I have noted that transformers designed for twenty-five cycle circuits are larger and heavier than those of the same voltage and kilowatt rating which are designed for sixty cycles. Why is this?

A. 1. The low frequency circuit for the same number of turns and the same voltage magnetizes the core to higher density. Now there is a definite maximum to which it is practicable to magnetize a core; the hysteresis and eddy currents, also the magnetizing current increase very rapidly at high densities; therefore, in order to keep the magnetization within permissible limits, it is necessary to make the transformer, having the lower frequency with a greater number of turns or with a larger core. Both of these are usually done and the transformer is thus larger and heavier than would be necessary for operating at a higher frequency.

Q. 2. What is meant by *all day efficiency?*

A. 2. All day efficiency is the total output in twenty-four hours divided by the total input in this time. In ordinary lighting work, the transformers are connected to the line during the whole twenty-four

hours of the day, while the consumers, we will assume, use the current from the transformers for five hours at full load. Since

All-day efficiency =

$$\frac{\text{Total Output}}{\text{Total Input}}$$

Which is equal to

$$\frac{\text{Full Load x 5}}{\text{Full Load x 5}}$$

Core Loss x 24 x Copper Loss x 5

Q. 3. Why are transformer cases often corrugated?

A. 3. The corrugations increase the heat radiation surface, thus allowing the heat to be dissipated more rapidly; and secondly with a given amount of iron, a stronger case can be made.

WAVE LENGTH QUERY.

(756.) John Bowden, Grand Rapids, Mich., desires:

Q. 1. What is the wave length of my antenna which is composed of four wires, each 200 feet long and 60 feet high. The lead-in consists of a single strand, connected at the highest point making an "L" shape.

A. 1. The natural wave length of your aerial is 500 meters.

Q. 2. I desire to know how far I can receive with the following instruments; a double slide tuning coil, 500 ohm telephone receiver, fixt condenser and silicon detector?

A. 2. With favorable weather conditions you should have no trouble in detecting signals for almost 1,500 miles.

Q. 3. What instruments will I require to employ in order to be able to receive Arlington time signals?

A. 3. A good loose coupler of 2,500 meters, two variable condensers, one across the secondary of the inductive coupler, the other across the primary, 2,000 ohm radio telephone receivers and a sensitive detector such as Radiocite, Lenzite or Audion. With the above mentioned instruments you will be able to receive Arlington's time signals and other long distant stations.

ALTERNATING CURRENT LAG.

(757.) H. Coldren, Helena, Mont., wants to know:

Q. 1. What governs the amount of lag in an alternating current?

A. 1. It depends on the relative values of the various pressures in the circuit, that is upon the amount of resistance and inductance, which tends to cause lag and the amount of capacity in the line which tends to reduce lag and cause lead.

Q. 2. Does the power factor apply to capacity reactance in the same way as to inductance reactance?

A. 2. It does. The angle of lag and of lead are, from the practical standpoint, treated as if they lay in the first quadrant of a circle. Even when the negative sign of the angle occurs, it is simply used to determine whether the angle be one of lag or of lead, but in finding the value of the angle from a table, it is treated as a positive quantity.

Q. 3. What is the maximum frequency that is possible with a Vreeland mercury tube oscillator and what is its efficiency?

A. 3. 8,000 cycles was the highest frequency ever obtained with such an oscillator to our knowledge. The efficiency is extremely low; in the neighborhood of about 5 per cent.

LEMON BATTERY.

(758.) A. Vaszin, Cleveland, Ohio, writes:

Q. 1. I cannot make the "lemon" battery work, as described in a recent number of THE ELECTRICAL EXPERIMENTER.

A. 1. We do not know why you have not been successful in operating a lemon battery, but quite possibly your failure with it is due to the fact that you have been using a battery type of voltmeter, and if such is the case the lemon cell will not give indication, owing to the fact that this class of measuring instrument possess a very low resistance. Consequently they require a fairly heavy current to actuate them. It is quite necessary that you employ a high resistance laboratory type of voltmeter for this test, such as the Weston instrument.

ATMOSPHERIC CHARGES FROM AERIAL.

(759.) R. E. Mathes, Excelsior, Minn., says:

Q. 1. Why is it that I can obtain long sparks from my radio aerial and receiving instruments?

A. 1. We have known of cases where this was due to the proximity of powerful wireless stations, which would induce powerful high frequency currents in the local antenna, when the phenonemon you describe would occur.

In some cases we have known of radio operators receiving heavy shocks from their radio instruments when a thunder storm had been in the neighborhood, which caused the antenna to become heavily charged with a large amount of electricity. In some cases the electric charge from the atmosphere on such occasions will pile up or accumulate to such an extent that it will eventually jump a gap as long as one to two inches.

The editor recollects of a case where heavy static charges were accumulated on a large aerial when the sky was perfectly clear; the effect in this case being due undoubtedly to the fact that the weather was cold and the aerial of extra large proportions, which, of course, resulted in an extraordinary accumulation of static electrical energy, which manifested its presence by jumping across the aerial switch.

NEW SUSPENDED ELEVATED RAILWAY SYSTEM.

(*Continued from page 875*)

imum vertical height of main structure; the narrow gage tracks, which result in minimum weight of trucks and their connections to the car; the elimination of the heavy track floor; the use of a single central post for double track; the use of three girders for double track in place of four and the use of central trusses and smaller trucks for the cars, which reduces the cost of all the rolling stock.

It is adapted to operate thru subways. The two systems can thus be combined wherever it is advantageous to do so, as thru certain downtown sections of the larger cities. Such operation in no way interferes with operation of subway or surface cars thru the same subways. The sponsors of this radical system state that it is especially adapted for express service, either three or four track, the three track system generally being found sufficient for all needs, and the design permits either carrying three tracks at the same level, or placing the 3rd track above the other two. Derailment is claimed to be impossible, so that high speeds can be safely obtained. As already stated, the cars cannot drop. The protected and enclosed tracks make perfection in operation of the signal system which insures safety, also permits automatic train control. Neither snow, sleet, rain, or other atmospheric disturbances affect the system. The only possible interference is failure of the power supply and if this happens, passengers are not marooned, as they can step from the car to the guide rail support, walk a few feet to the nearest post, and descend. There is no charged third rail to fear.

RADIO EXPERTS TO AID U. S. IN DEFENSE PLANS.

A committee of radio engineers, which will be composed of wireless experts and scientists, is being organized to co-operate with the Government departments for national defense.

V. Ford Greaves, radio engineer, in charge of the New York wireless district, was asked by the organizers of the movement in New York to be an honorary member of the committee. Greaves accepted the membership subject to the approval of the Commissioner of Navigation.

Among the men organizing the committee are: John S. Stone, consulting radio engineer of New York and one of the leading figures in wireless telegraphy in the world; George Davis, president of the Tropical Wireless Company, and E. J. McNally, vice-president and general manager of the Marconi Wireless Company.

BUILDING A 500 WATT DIRECT CURRENT DYNAMO

(Continued from page 900)

if expensive wood is being used or you run short. Finish the field poles so that they will fit the slight convexity of the inside of the ring. Glue them in place. Make a pair of legs to serve as a base. (Fig. 7.)

Probably end-bells or four-arm spiders for bearings would be very desirable, but they are almost out of the question for our machine. Such a casting requires a sand-core and that in turn requires an additional pattern. Fig. 9 shows how the pattern can be easily made for the bearings. With the aid of a wood rasp and sand-paper you can shape it nicely. It is built up in rough first from wooden blocks joined and glued. Now take the field pattern and fillet the corners with a mixture of plaster of Paris and thin glue. See Fig. 7. This is necessary or the moulder would not be able to pull the pattern out of the sand without breaking all the corners off badly. For the same reason the surfaces of the pattern taper slightly. In general, make your work strictly accurate and neat, allowing no sharp corners or edges and keep in mind how the work is to be tapered. Just imagine you are the moulder and then you will make fewer errors. When the filleting is dry, finish off any roughness or irregularities with sandpaper. Then saw the pattern directly in half and join the two halves loosely with a pair of wooden dowel pins. Do this accurately. Then give the pattern a couple coats of thin shellac, colored with lampblack. Now you can turn the patterns over to a foundry and have your field and two bearing pieces cast.

Have the inside of the (casting) field poles turned out to an accurate tunnel exactly 4 1/16 inches and the bearing pieces should have 1⅛ inch holes turned in them where the bushings fit. The base has ⅜ inch holes bored for lag screws. The bearings are each held by four machine screws, ¼ inch thread. Now turn out two brass bushings that fit the shaft and are about 1 inch in diameter. They are made long enough to reach thru the bearing casting. Wrap paper around the armature till it fits in the tunnel of the field tightly. Then put on the bearings and slip the bushings in place. The space between the bushing and casting can now be babbitted in, making the bushings line up with the shaft exactly. A pulley 2½ inches in diameter and having a 2 inch face can be made from laminated pieces of oak and a metal center.

The field coils are wound on a form having a wooden core 4½x5x1¾ inches. The winding is made 1½ inches deep. Tape them well with stay-binding or cotton tape and bend the coil over a round stick of wood, so that it fits somewhere near the

curvature of the field ring when slipt in place. The coils are treated with insulating varnish and baked dry. They are held in place by four nails, driven in holes drilled on either side of the magnet cores. They are next placed and connected on the machine so that one magnet shows a *north* pole and the other *south* as indicated by a battery and compass test.

Now by driving the machine and exciting the fields with a couple of dry cells, and holding the leads of a voltmeter on the commutator, you can explore and find the neutral axis on the commutator where the brushes should touch. The highest voltmeter reading indicates the position. Now for the brushes. With machines giving over 10 volts it is an advantage to use carbon brushes. They should present an area of 1 square inch on the commutator for every 40 amperes. A brush ⅜x¾ inches with a capacity of 12 amperes will serve our use. Fig. 10 shows the brush holders and arrangement.

When your machine is all assembled, lift the brushes and magnetize the field from several dry or storage cells. Let the brushes down again and bring the speed up to 1800. Cut out all field resistance and put a voltmeter across the brushes. Watch for a reading. If it does not build up, reverse the belt. If still you do not obtain results, magnetize the field in the opposite direction. And it might be well to press hard on the brushes to lower their high resistance to the weak *building-up currents.* Adjust the field resistance so that your voltage shows 50 at rated speed. A power source of about 1 horse-power is necessary to drive it.

The author obtained alternating current from this machine by connecting a pair of slip rings to diametrically opposite points on the commutator as shown in Fig. 10. The photo shows the completed machine, which was driven successfully by a motor cycle engine.

In conclusion the writer wishes to say that no detailed method of mounting the commutator was given. The builder may fasten it on by a set screw, counter-sunk in the commutator shell, or the shaft could have been made of ⅞ inch stock; then the core could have been threaded on and the ends turned down to ⅝ inch for the bearings. While the procedure of design given here may not be engineering perfection, the writer hopes some will find an interesting and practical use of knowledge they have probably covered previously in text books.

EXPERIMENTAL CHEMISTRY.

(*Continued from page 906*)

Fig. 54 shows the structure of the flame of a candle, and it will be noticed that there are four parts to the flame. 1. The greenish-blue region at the base. 2. The dark or black non-luminous cone. 3. The Luminous cone, and 4. the Blue mantle.

EXPERIMENT NO. 45—

To show the relative temperatures of the different parts of flame apply the following tests: Have a Bunsen burner flame about 8 cm. high, and press down on the flame with a piece of paper about 5 by 7 inches, grasping the corner of the paper and pressing it down horizontally over the flame. There must be no draft of air blowing or any blowing of the flame, and several attempts may have to be made before a good result is obtained. As soon as the paper begins to burn or char, take it instantly from the flame and blow it out if the paper is burning. The paper should be forced down to within about 2 cm. of the lamp. By repeated experiments a result will finally be obtained which will show not only the horizontal structure, but also the hottest parts of the flame and those parts in which the temperature is low.

EXPERIMENT NO. 46—

The object of the following tests is to show in what parts of a flame combustion takes place. Lay for a few seconds a match stick flat across the Bunsen burner flame about 1 cm. above the top of the lamp. Observe the results (see Fig. 55).

Turn off the gas and, having run a pin thru a match 1 cm. or less from the head (which must be unburned), drop the match into the lamp, leaving the head of the match in the center and above (see Fig. 56). Now turn on the gas jet and light it far above the match. It is essential that there is no draft of air.

It will be noticed that the match does not burn. This would show that there is no combustion in the inner cone. As a match contains Potassium Chlorat or Potassium Nitrat ($KClO_3$ or KNO_3), this test does not show that the reason for non-combustion is due to the lack of oxygen. On the contrary the oxygen is contained in both the $KClO_3$ and KNO_3, but not in a gaseous state. The reason for non-combustion is due to the fact that there is neither air nor sufficient heat to cause it to ignite.

EXPERIMENT NO. 47—

Take a piece of glass tubing about 15 cm. long, draw it into a point and file and break it at the middle of the construction (do this in a similar manner as done in making the stricture tube described in the March issue, except that the glass is not bent, but pulled out straight). Insert the other end in the inner part of the Bunsen flame, near the base but not down into the lamp (see Fig. 57). Hold this steady in the left hand at an angle of about 45° and with the right hand hold a lighted match to the end and notice that the gas from the inner cone is led thru the tube and can be ignited at the end. This would also show that there is no combustion in the inner cone, because if such were the case it would be rather difficult to lead a flame thru the length of the tube, and if this could be done the flame would be noticed in the tube.

From the above experiments we can show that there are certain conditions necessary for combustion, viz., a *combustible substance* and a *supporter of combustion.* The other condition necessary is that the temperature be raised to a point at which the substance takes fire and burns (known as the *Kindling Temperature*).

EXPERIMENT NO. 48—

Obtain a block of willow charcoal and bore a slight depression near one end. Into this depression place about half a gram of Lead Oxid (Litharge) PbO. Light the flame of the Bunsen burner, about 4 cm. Practise blowing the blowpipe by applying the heat to the litharge. The flame of the blowpipe should have a nearly horizontal position, and you should be able to distinguish clearly the two parts. After you feel that you can blow the flame so that you can regulate it satisfactorily, take the charcoal in the left hand and, holding it slightly inclined, gently blow onto and against the litharge, so as not to blow away the powder, but gradually increase the strength. Continue blowing for some time, having only the inner flame on the oxid (see Fig. 61).

After having been reduced to a point where the litharge turns to a globule, remove from the flame. It will be noticed that this globule is lead. The oxygen of the lead oxid has been driven off by the application of the blowpipe heat, the reaction being as follows:

Pbo	=	Pb	+	O
Lead Oxid		Lead		Oxygen

When Carbon, sulfur, hydrogen, etc., are burned, they must be raised in temperature

to a given degree before they will burn. This point is called the *Kindling Temperature,* and it varies for each substance. Below this point the given substance will not burn, but at or above its kindling temperature it takes fire (even spontaneously) in the presence of a supporter of combustion. Substances may be made to burn under water, and flames may be frozen out by cooling below the kindling temperature.

To illustrate the kindling temperature more clearly we will take the following:

In making a coal fire we know that it is necessary that paper, wood and coal be burned in the order named. We could not light the coal with a match and while we may be able to light the wood, it would be impracticable. We therefore employ the easiest method, by lighting the paper, which has a very low kindling temperature, and the nadding wood, which is raised to its kindling temperature by the heat of the paper. After the wood is lighted and gives off heat, we add the coal, which in turn is ignited by the heat of the wood.

If the burning material is a good conductor of heat, as iron, the heat is conducted away so rapidly that the temperature falls below the kindling temperature and the fire goes out.

EXPERIMENT NO. 49—

Arrange the apparatus as shown by Fig. 60. Have the gas turned off and set the wire gauze 2 to 3 inches from the top of the burner. Turn on the gas and let it flow for a few seconds, then apply a light above the wire gauze.

This principle is used in the Davy's miner's lamp, and thus prevents explosions in mines which are caused by CH (*fire damp*) escaping from the coal and mixing with the air and being ignited by any flame from the lamp. This lamp is surrounded by thin mesh wire which keeps the gas outside the lamp at a point below its kindling temperature, and even tho inside the flame is burning vigorously, it will not ignite the gas. The iron wire conducts the heat off so rapidly that it does not raise to a point whereby the gas is ignited.

EXPERIMENT NO. 50—

Grasp a piece of iron (4x4 inches) gauze by one corner, and push down flat over the flame of the Bunsen burner. You will notice that the flame does not pass thru the wire gauze until the iron becomes hot enough to heat up the portions of gas above the gauze. Before repeating the experiment allow the gauze to cool, otherwise the experiment may not work. The reason that the gas does not pass thru the gauze has been explained previously; as soon as the gas below heats the gauze to a point which is the kindling temperature of the gas above, it takes fire and burns.

EXPLOSION

If a lighted match is brought close to a mixture of hydrogen and oxygen in a confined space, an *explosion* ensues. The flame brought to the edge of the mixture rapidly spreads thru the whole, and combination takes place in all parts practically at once. The great heat liberated by the sudden union of the whole volume of gas expands the product to many times its original volume, and it almost as suddenly contracts. The sudden expansion forces everything else aside, and, if the gases are confined, tends to break the confining walls, producing an explosion. In the contraction which follows, the molecules roll over each other and rush back, and thus there are two indistinguishable sounds following in rapid succession. Quick combustion in a confined space makes an explosion, if the substances are intimately mixed.

A chemical explosion involves five conditions: 1. A combustible, 2. A supporter, 3. A kindling temperature, 4. An intimate mixture, 5. A confined space.

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

CAMERA.

(134) Harry Lytle, Akron, Ohio, writes as follows:

"An invention that operates the camera in such a manner as to enable a person to take his own picture without using a string. My invention is controlled by sound. Do you think the scheme is patentable?"

Our correspondent also gives us further information on the device.

Answer. While the idea is a good one, we doubt very much whether it is commercially practical. There is not enough demand for such an article, we think, to have a manufacturer put it upon the market, because very few people as a rule take their own pictures. Suppose there was such a device on the market, would you be tempted to pay say from $1.00 to $3.00 apiece for an apparatus of this kind, merely to take your own picture? We do not think you would. It is one of those things which, while the idea is good, there is not sufficient demand for, to warrant patenting it.

LOOSE COUPLER.

(135) Frank McMullen, Lairchance, Pa., says: "Is the enclosed hook-up for switches and location of secondaries new, and could a patent be obtained on them?" The device is a loose coupler having twin secondaries.

Answer. Nothing new seems to be presented in the device except a certain phase of the switching arrangement, and we doubt very much whether, even tho a patent could be obtained on the switching arrangement, such a patent would be worth much to the maker. Twin loose couplers of this kind have been described years ago in *Modern Electrics* and THE ELECTRICAL EXPERIMENTER, and therefore nothing new is contained in at least this phase of it.

TELE-TRANSMISSION.

(136) R. K. G., Clay City, Ind., writes to us as follows:

"I am sending plan of my instrument by which geometric figures, pictures, newspaper prints, letters, etc., can be sent by wireless. It is based on Electrolysis. Is this idea practical? Would it pay to have it patented?

Our correspondent furthermore says he has a way to send photographs, also a new method by which a person at one end of a line would be able to see the person at the other end!

Answer. In the description and drawings submitted, nothing new is presented. The method of sending pictures by Electrolysis is at least seventy years old, and the difficult part in order to transmit pictures and drawings correctly is due to the fact that it is almost impossible to obtain complete synchronism at both ends of the line at all times. Usually there is what is known as *distortion*, which very frequently happens with the best machines of this sort.

As for the last idea, namely *tele-transmission*, so far we have not seen anything that really would work, and if our correspondent really has such an instrument, he had better take it to the Patent Office without much delay, as it is probably one of the greatest inventions of the century.

ANTENNA CONNECTOR.

(137) Nicholas Maynard, Sabetha, Kans., has submitted to us a rather novel antenna connector, which does away with soldering and other difficulties in connecting aerial wires as well as lead-in rat-tails. Only two screws are used on the device, which is light and simple of construction. Our advice is asked on it.

Answer. It is an excellent idea and we think it is worth patenting. This article does not seem to rust connections, and it appears that good contact should be readily had at all times, which is an important factor in antenna connectors. We would advise our correspondent to get in touch with a patent attorney.

MOVABLE AUTO HEADLIGHTS.

(138.) Howard J. Heim, Dawson, Neb writes:

"I wonder how many motorists in turning corners at night know of the danger which exists on the other side of that corner. The bright shaft of light from the headlights sent out straight ahead, only intensifies the darkness at the side into which the car runs. Why not turn the headlights so that they will point in the direction the car is going. Am enclosing drawing which explains the idea. Would appreciate your opinion as to its practicability and whether it is enough so, that it would be commercially valuable if patented?"

Ans. A similar device to this is on the market already and by looking up any catalog of a large automobile accessories company, the moving headlights will be found listed. We saw such headlights for the first time about eight years ago, but somehow or other they do not seem to be a success.

ELECTRIC APPLIANCE.

(139.) Joe Street, Los Angeles, Calif., sends us specifications and drawings of an

electrical appliance in the form of a cord adapter. He states that almost everyone has several appliances to be attached to lamp cords, and with this device the extension can be turned in a moment's notice into an extension cord which is very handy to have around the house at all times. Our advice is asked on the invention.

Ans. The idea seems to have some rather good and novel points and we think there is a possibility of obtaining a patent on it. There seems to be a commercial possibility for the device in our opinion.

AUTO ACCESSORY.

(140.) Ernest Rerucha, Brainard, Neb., writes:

"I have worked out an idea of a signal dummy for automobiles of which I am enclosing sketch for your inspection. Will you kindly advise if the device could be patented and if it would pay to patent it. The idea is to have a dummy fastened to the radiator cap and the device is to close the circuit to the horn of the car while its hand is holding a trumpet to its mouth which would make it seem as if the dummy made the noise."

Ans. We do not see the usefulness of this idea, and at best it is nothing but a novelty which we hardly think would prove a commercial success. While a Design Patent may be obtained upon it, we think our correspondent will find it rather hard to dispose of the patent.

TYPEWRITER ATTACHMENT.

(141.) Walter G. Johnson, Salem, Neb., writes us:

"I wish to submit for your consideration an idea and ask your advice upon it as a patentable article. I wish to put a small inexpensive attachment on the typewriter to return the carriage automatically when the end of a line is reached. Such a device would save time and the necessity of removing the fingers from the keys so often. It would operate with a spring and therefore would be inexpensive."

Ans. The idea is as good as it is old. Nothing new is contained in it save that no one has been able to turn out a device that would stand up under all circumstances and which could be incorporated readily in any typewriter. There is no doubt that there is a large and insistent demand for a device of this kind, and a good attachment of this sort would certainly be worth a great deal to the inventor.

POCKET ELECTRIC FLASHLIGHT.

(142.) Ansley Newman, Buffalo, N.Y., wishes our opinion as to patentability and commercial value of a pocket electric flashlight combined with a cigarette case. He claims that standard flashlight parts would be available and thinks it could be manufactured at the price of an ordinary flashlight.

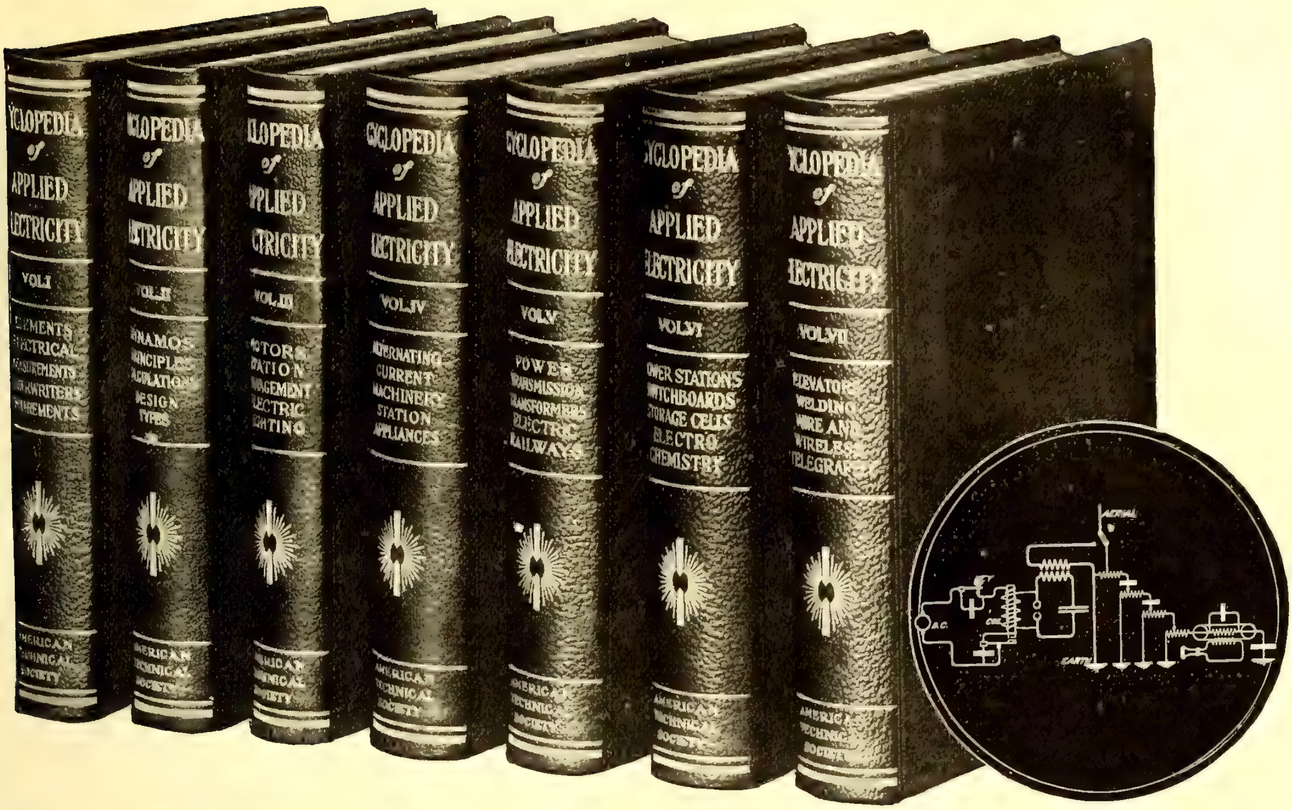
Ans. The idea is not new nor does there exist a great demand for an article of this kind. We do not think that a patent could be obtained upon the article.

ELECTRIC FIXTURE.

(143.) Willard Allphin, Portland, Ore., has sent us in a sketch of a certain electric fixture and states:

"Recently I tried to purchase a certain fixture like the one in the drawing submitted, and was told, to my surprise that there was no such thing on the market. I wish to know if a similar fixture has ever been patented and if you think it is practical."

Ans. While this fixture shows some novel points, we hardly think it is patentable, as there are very similar articles on the market which do the work. However, you might get in touch with a patent attorney for further advice and search for patentability.



NEW SPARKLESS SIGNAL.

A new system of sparkless signaling has been evolved in England to comply with the Home Office requirements. The bell is of the solenoid type, into which a simple, but at the same time very important, improvement has been recently introduced, so as to enable the bell to be put in service on an alternating current supply of any voltage. The device consists of the provision of an elongated slot in the gong standard for the rough adjustment, and a quadrant on the gong base for the fine adjustment. This provision enables the relative position of the gong and tapper to be varied in accordance with the voltage passing on the circuit.

For below-ground signals a tremulous bell is a *sine qua non,* and as hitherto it had not been found possible to obtain this tremulous action with the solenoid bell worked off a direct current supply, it became necessary to devise a means to accomplish this purpose, the makers wisely determining to retain the solenoid action. The solenoid is not only the simplest, but also the safest form of electric bell. The danger with the ordinary bell lies, of course, in the self-induction set up by the amount of iron used in the coils. The solenoid does not require the same amount of protection, owing to the iron plunger being less in diameter and shorter in proportion to the size of the coil; further, the plunger is movable, and does not occupy the whole number of turns wound on the coil, which to all intents and purposes is precisely what the Home Office stipulates.

A simple method has been evolved for imparting the necessary tremulous action to the bell. The high-induction relay is, perhaps, best described as a tremulous relay, which, by means of a long spring, makes the trembler contact. The sparks which would form at the contact points are damped in the condensers, the relay having a non-inductive winding. This damping of the sparks in the relay is a provision which will be grealy appreciated by mining electrical engineers, to whom sparking contacts are a constant source of trouble.

From the foregoing it will be seen that from the wires right thru to the bell there is no possibility of sparking. The relay is contained in a stout cast-iron case, the cover-joints having broad machined faces. The cover is secured by three bolts and a lock hasp, which is past thru a square hole, preventing the cover being turned on the lock bolt, even tho the other three bolts are removed. The containing case, however, may be regarded as merely a protection to the relay mechanism, as it is clearly not necessary to the factor of safety. The bell circuit is entirely distinct from the signalling lines. In the installation inspected this was worked off a twelve-volt supply, and the line or relay circuit from a four-volt supply.

MARCONI WIRELESS CO. OFFERS SERVICES TO U.S.

The Marconi Wireless Telegraph Company of America will, in the event of an emergency, place its entire organization at the Government's disposal, it announced in a telegram recently sent to President Wilson.

The equipment includes high-power stations at Marion and Chatham, Mass.; New Brunswick and Belmar, N.J.; Bolinas and Marshall, Cal., and at two towns in Hawaii, and there are about sixty coastal stations along the Atlantic, Gulf and Pacific and Great Lakes coasts, including those in Alaska.

Manufactories and workshops are included in the proffer, together with a trained staff of men.

NEW AUTOMATIC ELECTRIC BUOY NEVER FAILS.

(Continued from page 871)

in operation, the front of the float being partly removed to show the mechanism. For better explanation it is shown here with open gears, while the same would actually be encased and running in oil or grease similar to the generally known bench grinders, in which one turn of the handle causes 16 to 20 revolutions of the emery wheel.

A gas-buoy requires to be re-filled with fuel every few weeks or months, with frequent replacing of broken mantles and burners and the lamp cannot be closed air or water tight as it must have air-circulation. Furthermore they require a special sensitive flasher to save fuel and often also a special clockwork which prevents the burning of the light during daytime, etc.

This automatic electric light buoy is so simple that it can be made for a fraction of the cost of a gas-buoy and after it has once been anchored in water it does not require any further attention for years its inventor claims. The water will develop the electric current, the few gears run in oil or grease, and the life of the lamp is practically unlimited.

We may hope to see such buoys soon distributed all over the world and it is a poetic idea that the same water which endangers the life and safety at sea will at the same time with the help of electricity and human genius contribute to safety. The more a gale rocks the buoy, the stronger the warning light.

THE AUTOMATIC RESTAURANT.

(Continued from page 872)

operandi of obtaining just one cup of coffee. To begin with you advance on the unsuspecting electrical coffee dispenser—place a cup under the nozzle—drop a nickel (Tip—slugs won't work it) in the slot and turn the knob beside it. In two seconds a stream of coffee, including the cream, issues from the spout and *just* fills the cup. The front and rear of the coffee dispensing machine are illustrated here, with a patron in the act of obtaining a cup of coffee—or it may be tea or chocolate. Black coffee, too, is available.

These machines proved to be one of the most difficult of developing, owing to the fact that liquids had to be handled and moreoover they must be kept hot *continually*. When the patron inserts a nickel in the mechanism, the electrical dispensing apparatus immediately gets busy. A powerful electro-magnet sucks up an iron piston, which is linked mechanically with the coffee and cream tanks, the mechanism being so accurately built that for each nickel inserted in the coin mechanism, the machine releases from its hot coffee and (cold) cream tanks just a sufficient quantity to fill a cup. Sugar is available on all tables and the patron sweetens the drink to suit his (or her) particular fancy.

Before going further it should be explained that a special kitchen staff keeps the food cylinders (each cylinder contains several similar compartments) and liquid tanks always full. A suitable space extends along the entire length of machines for the maintenance staff. Several men are constantly on duty in the restaurant proper, collecting soiled dishes, rearranging chairs, etc.

Of course you would not always want baked beans, a sandwich or a piece of pie and cup of coffee. For those epicures whose appetites rise beyond these or simi-

lar limitations, there is available the *special order* board. The two illustrations herewith show the front and rear of this ingenious electrical garçon.

The front of this panel carries several dozen labels—"Hamburger steak," "country sausage," "pork chops," "roast beef," etc., etc. Suppose you decide on "pork chops." Possibly this is labeled "four nickels." You proceed to deposit the required four coins in the convenient slot corresponding to the dish ordered. When the last coin has been deposited two things happen—a tiny electric flashlight on the rear of the board lights up just over a small sign reading "pork chops." The chef notes the dish ordered and immediately starts cooking it. In front of the panel there is a special slot, thru which a *receipt slug* issues. This slug is labeled with a letter such as A, B, C, etc., the letter corresponding to a certain glass oven, of which there are several on either side of the special order board. Suppose your receipt slug calls for oven "E." When the chops are ready the chef places them in oven "E." You then insert the slug in the slot beside the proper oven and a turn of the knob releases the glass door, enabling you to reach in and remove the victuals. Bread and butter are served with most of the special orders. Knives, forks and spoons are placed on a ledge or shelf running along the front of the machines. If the dishes served in a certain section require spoons only, then nothing but spoons are placed on the service shelf. Of course if you simply must eat your peas with a knife or your ice cream with a fork—why, you can readily obtain a knife. Oui monsieur! The French is ours; the machines have not been cultivated to reply in any language as yet. Can you imagine what would happen in the rush hour if the record ever slipt!

Besides the many electrical features of the Automat serving machines, there are a number of the interesting sidelights which the outsider never sees. Think for a moment of the thousands of soiled dishes to be washed every hour. The attendants collecting these dishes from the tables bring them to a convenient and specially devised dumb-waiter, which shoots them basement-ward. Here a husky member of the dish-washer's brigade takes charge of the basket of soiled dishes and places them on the runway approaching the electrically operated dishwasher. The latter comprises two tanks about three feet apart. The basket of soiled dishes is hooked onto the chain extending from the crane arm (see photograph), and as soon as the motor is thrown on the basket is rapidly oscillated up and down in the first tank containing warm water and soap. After several oscillations in this tank, the basket of dishes is swung over to the second tank, containing hot water and thru which steam is forced. This terrific scalding thoroly cleanses the dishes after a few oscillations of the basket and by the time they are lifted out of the tank the hot water has evaporated, leaving them perfectly dry—towels are never used. A similar process is used for washing the cups which are washed separately. Result: No Greasy Cups!

You possibly have wondered how ice cream could be left standing in the service compartments, in full view for hours. Here's the secret. Those compartments are frigidly cold, and maintained so by a pipe running thru it, connected to an electrically driven refrigerating machine. On the other hand the hot dishes are kept so by steam pipes.

And last, but by no means least, we have the nickels—mountains of them. Of course it would take hours for an expert to count them, so the management has installed a nickel *counter and tabulator.*

EXPERIMENTAL PHYSICS.

(Continued from page 887)

position, insert a rubber stopper D, with a piece of glass tubing C in it, having a nozzle at the end E. B is a piece of rubber tubing and A a pinch cock. The thumb and forefinger may be substituted for the pinch cock. As soon as the tube B is placed in the jar S and the pinch cock released the water rushes in in the form of a fountain. This phenomenon is explained by the fact that ammonia gas is highly soluble in water and hence as some of the ammonia dissolves more and more water rushes in to take its place.

All of these experiments are easily explained by the Molecular Theory of Matter and the Kinetic Theory of Gases. We accept these theories because they explain phenomena for us satisfactorily, while many phenomena cannot be explained by any other theory. Briefly they may be stated thusly:

(*Molecular theory*)—The fact that gases can be compress, and that one substance can be dissolved in another leads us to believe that space is not entirely filled by the matter of which a substance is composed; that is, the particles of matter do not really touch each other. These particles are called molecules and they are the smallest parts into which a body can be divided without destroying the substance as such. Molecules are so small that they cannot be seen even by the most powerful microscopes, but they manifest themselves to us by their behavior. Lord Kelvin calculated their size in some substances (they vary in size for different substances) and he found that if a football full of water were magnified to the size of the earth, the molecules of the water would occupy spaces intermediate in size between buck shot and footballs. The *Kinetic theory* states that the molecules of all bodies are in rapid motion and the three states of matter may be considered as the result of the various kinds of motion of the molecules and their relative velocities. In solids, the motion of a molecule is restricted to a limited space and its position with respect to the other molecules is relatively fixt. Hence the solid retains its shape. In liquids the molecule is free to move in any direction, *i.e.*, it can glide over the other molecules and the liquid will take the shape of the containing vessel. In gases the molecule has a very high speed and moves in a straight line until it comes in contact with another molecule, or with the containing vessel's walls. Because of this high speed a gas cannot be kept in an open vessel, for no matter how small or how large the vessel, and no matter how small the quantity of gas, it will always fill the vessel in which it is confined. In accordance with this theory, heat is nothing but a motion of the molecules of a substance. Pressure is simply due to the bombardment of the molecules of a gas against the sides of the containing vessel. Thus when we compress a gas we have more molecules in the original space and the bombardment is greater, and hence the gas rises in temperature and its pressure becomes greater in accordance with *Boyle's Law*.

EXPERIMENT 18—

Open a bottle of ammonia water and stand off at a distance. In a short time the fumes of ammonia gas will reach you. This is easily explained by our theory. The gas being left in an open vessel, its molecules move off to fill the room and sooner or later reach us.

EXPERIMENT 19—

Pour a little alcohol or ether in a saucer. In a short time the alcohol or ether disappears. Here we have the case of the molecules of a liquid moving rapidly enough, so that in a short time they have left the original space. In Experiment 11 we saw how water (a liquid) was changed into steam (a gas) by heating. This is also in accordance with our theory, since heat and motion of molecules being identical, by applying heat to the water we caused its molecules to move faster and finally fast enough for them to leave the original space.

EXPERIMENT 20—

Fill a test tube about half full of water and mark the level with a rubber band. Do the same with alcohol in another test tube. Now very carefully pour the alcohol into the test tube containing the water and shake vigorously. If enough of the mixture is poured into the other test tube to reach the mark we find that the mixture occupies less space than the two original liquids did. There is nothing remarkable about this when considered from the molecular standpoint. For example, we might have a quart basket containing a quart of potatoes and another quart basket containing a quart of peas. It is easily seen that some of the peas will fill the spaces between the potatoes and that on mixing together we will not have two quarts, *but less.* This is identically what happened in the case of the water and alcohol. Some of the molecules of the alcohol went into the spaces between the molecules of the water. Actually, the space between the molecules of a gas are considered to be larger than the molecules themselves.

EXPERIMENT 21—

Place some alcohol or ether on the hand and notice the cooling sensation. The *Kinetic theory* furnishes a very simple explanation of this cooling effect. When a liquid is evaporating some of its molecules are leaving its surface and naturally the most rapidly moving ones are leaving. By the continual loss of the most rapidly moving molecules the average speed of the molecules of the liquid is becoming less and less and hence *since the average speed of the molecules determines the temperature,* the temperature gradually falls and we feel the cooling sensation.

(This subject will be continued in the next lesson.)

"WITH THE AD-MAN"

(Mr. Hymes' last message)

I want you to read a paragraph that the late Elbert Hubbard was fond of distributing. He was proud of it. There's a world of truth and common sense in it. Won't you please read it twice and than paste the clipping somewhere where you can see it often? Not that you need it, but I'll wager if you believe in it you will go up the ladder faster.

Elbert Hubbard called it

Horse Sense

If you work for a man, in heaven's name work for him. If he pays wages that supply you your bread and butter, work for him, speak well of him, think well of him, stand by him, and stand by the institution he represents. I think if I worked for a man, I would work for him. I would not work for him a part of his time, but all of his time. I would give an undivided service or none. If put to a pinch, an ounce of loyalty is worth a pound of cleverness. If you vilify, condemn and eternally disparage, why, resign your position, and when you are outside, damn to your heart's content. But, I pray you, so long as you are a part of an institution, do not condemn it. Not that you will injure the institution—not that—but when you disparage the concern of which you are a part, you disparage yourself.—Elbert Hubbard.

Do you think it good?

MILTON HYMES.

THE WASHINGTON'S BIRTHDAY RELAY AND THE Q. R. M. LEAGUE OF AMERICA.

(Continued from page 888)

wireless message across the Rocky Mountains from old KPJ, San Pedro, and delivered it in Denver. A letter from the Marconi operator on the steamship *Columbian,* while en route to Chile, says: "Your signals were easily read for three nights while making tests with your stations. The last night out this steamship was over 1,800 miles from Denver. They were not lacking in enthusiasm, however, as the sinking of the ill-fated *Republic* in January, 1909, and the famous wireless rescue of over 1,500 persons, served to awaken the Denver amateurs to the possibilities of the new art.

You will see in this magazine shortly the results of the Relay, elsewhere we show a picture of the large silver trophy which the author will donate to the most efficient and best equipt wireless amateur station in the United States. This does not mean that your apparatus must be high grade, but it does mean that it must be efficient, properly arranged, and that your station is popular because it is not black-listed on account of continually causing Q. R. M.

Scientific Exchange

UNDOUBTEDLY you have at the present time some things for which you have n[illegible] for something, for which you have immediate use? There is no surer and quicke[illegible] articles in these columns. The *Very* people, the *Only* people, who could possibly have a[illegible] More than 75,000 interested people will see your ad. It is furthermore the cheapest adver[illegible]

Dealers' advertising accepted in Opportunity Exchange Columns only.

The rates are: *Three cents per word* (name and address to be counted), minimum space 3 lines.

Remittance must accompany all orders. No advertisement for less than 50c. accepted.

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectio[illegible]

[illegible] May issue should reach us not later than March 25th.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

Subscribers experiencing trouble in dealing with any advertiser should notify the publisher very promptly.

OVER 75,000 PEOPLE READ THIS JOURNAL

FOR SALE—My 2000 mile radius Ideal Receiving set complete, including 4000 meter Coupler, Navy Type, Audion, Oscillating Bulb, Loading Coil, Brandes 2000 Ohm Phones, 100 Ampere Lightning Switch, three full copper wire 100 foot Aerial, a BARGAIN at $70.00, cost [illegible]. Reason selling, am buying same kind only larger. Write quick. E. A. Wilton, 1124 W. Edwards St., Springfield, Ill.

CABINET RECEIVING SET comprising Navy Tuner, two Variables, and other necessary instruments. Bargain to quick buyer. Address, G. J. [illegible], 2137 Lexington Ave., New York City.

FOR SALE—Navy type receiving transformer and Audiotron panel, new "B" batteries and bulb, $17.85; small 110 v. motor, $3.35; 2 new [illegible] bulbs, $4.35 each. All excellent condition. Wanted—rotary quenched gap, 1 K.W.; [illegible], variables, mounted or unmounted. R. [illegible], Midland, Mich.

TRADE—¼ H.P. 133 or 125 cycle A. C. Motor for Audion, Audiotron, or Transmitting Apparatus. H. C. Ross, 1087 Schilbi St., Columbus, Ohio.

FOR SALE—4 Kingston Auto Coils 25c each; little Hustler Motor, 40c; seven 25c books, 20c each; one carbon Transmitter, 50c; Ithaca 10 gauge double shot gun, $11; have some coil boxes and master coil cheap. Edgar Lerew, York Springs, Pa.

FOR SALE—Complete wireless transmitting and receiving set in good condition, price $10. Donald Shoemaker, Laketon, Ind.

WANTED—Tape register stock ticker, cash only. [illegible] Newton, Suffolk, Va.

FOR SALE—Two 6 volt 14 ampere "Electro" Generators, never used. Sacrifice, $10.00. Ned Valeri, 388 St. Mark's Ave., Brooklyn, N.Y.

FOR SALE—Murdock coupler, fixed condenser and [illegible] ohm phone with head band and cord; cat whisker; detector; variable condenser. Cost $21, sell for $10. Maurice Mc Cune, 1404 Homewood Ave., Pittsburgh, Pa.

SALE OR EXCHANGE—3 K.W. key, Brandes Superior, Duck $2.25 Detector, Cabinet Coupler, 4 pounds No. 14 Alumium, 2 Marconi bushings, Switches, etc. H. H. Lee, 956 Water St., Port Huron, Mich.

WILL SWAP—Brandes Phones, $11; RJ4 De Forest Audion, $12; Thordarson 1 K. W., $19; 1-16 H.P. Universal Motor, $4; Eveready 4 V. 40 A. Storage Battery, $8; ½ K.W. mounted Packard Transformer, $8. Wilson Smith, S. Wayne St., St. Marys, Ohio.

EXCHANGE—Gray & Davis Ford Starter $30 cash. Want electrical, mechanical books for nice [illegible]. [illegible]er Estill, Glasgow, Mo.

WANTED—3000 ohm receiver and burnt out [illegible]. All letters answered if stamp enclosed. William Orman, Columbia, Tenn.

LARGE GUARANTEED 2500 meter Navy Type Coupler $5.50. Send 2c stamp for photo. [illegible] oil-immersed condenser cheap. C. H. [illegible]uschenberg, Box 386, Charleroi, Pa

BARGAIN—$12 type BB crystaloi detector, $7.50. Good condition. Innes Harrell, Valdosta, Ga.

SALE OR EXCHANGE—Fifty Ohm Relay, $1.3[illegible]; 20 Ohm Sounder, $1.10; Telephone Receiver, 75c; Transmitter, 85c; Three Magnet Generator, $1.75; 4x5 Plate Camera, fair condition, $[illegible]; 15 pair Electro Magnets, pair 20c. Everything prepaid. Want: 2000 ohm Headset; Spark Coil; Baby Knife Switches. Will pay cash. Otoe Goff, 1403 5th Corso, Nebraska City, Nebraska.

FOR SALE—$40 Course in Meter Engineering, $5; also Telephone, Receivers, Inductance coils, Pressure Gauges, Marble Base Knife Switch, Drill books. Send for list. Jean Eiler, 125 North Harvey Ave., Oak Park, Ill.

NAVY TYPE COUPLERS, 4000 meter, $6.50; 2000 meter, $5; 200 meter, 75c; Murdock variable, $2.40; Cylindrical plate variable, $1.90; Audiotron detector, $12; Brandes phones, $3.75; 2 inch spark coil, $5.50; 1 inch spark coil without vibrator, $1.25; Oscillation transformer, $1.25; Desk Telephone, $4.50; B-flat cornet, $4.50. Rule D. Eg[illegible], Ohio.

TREMENDOUS WIRELESS BARGAINS—Here is your opportunity to secure first class wireless apparatus at real bargain prices. Everything absolutely as represented. 5 K.W. type E. Clapp-Eastham transformer; four variations of power; not in case. Rubber switch panel is cracked, also rubber secondary posts. Transformer is in excellent working condition. Cost $262. Special sale price $35. 5 K.W. type E. Clapp-Eastham transformer in case; four variations of power. One of secondary coils burned out which has to be removed and new one put in its place. Otherwise in splendid condition. Cost $262. Special sale price (a big bargain), $10. 3 Clapp-Eastham glass plate condensers in cases. Each case over 2 K.W. capacity. Good as new. 22 condenser sections to each case. Cost each $55. Special sale price per case of 22 sections, $13. 5 K.W. Clapp-Eastham oscillation transformer, helix style. Genuine copper edgewise wound strip. Primary has 8 turns and secondary 13 turns. Insulated on rubber posts almost 18 inches in height and 2 inches in diameter. In splendid condition. Cost $50. Special sale price, $12. 5 K.W. Clapp-Eastham straight spark gap in case. Has brand new zinc alloy sparking points. Cost $60. Special sale price, $5. 5 K.W. Clapp-Eastham Antenna Switch. Good as new. Cost $20. Special sale price, $5. Clapp-Eastham receiving set. Loose coupler made of hard rubber mounted in polished cabinet. Mineral detector on top with large variable condensers on each side, but inside cabinet. Adjusting knobs in front. Primary and secondary of coupler has sliders. No cheap construction. In splendid condition. Special sale price, $14. Clapp-Eastham receiving set. Loose coupler mounted on top of case. Has two ferron detectors and large variable condenser on each side of detectors. Primary and secondary of coupler has sliders. Splendid condition. Special sale price, $11. "Electrose" insulators, 10½ inches in length. Same as used by commercial stations. Cost each 50c. Special sale price, each, 20c. Purchaser to pay freight or express charges. Positively no trades. Remit by money order only. Checks not accepted. Order quick. Sydney Friedrich, 350 East Commerce Street, San Antonio, Texas.

MIGNON R.C. 1 for $6 money order. In perfect condition; knobs, etc., better than on new instrument. Prepaid. Eric Kraemer, 1037 Ramona St., Palo Alto, Cal.

FIRST $17.50 takes Audio-Tron Panel Detector with B-Battery, Chamber's Coupler, 2 fixed condensers, Tel Radion, switchboard, loader. All new. Throw in tuner if quick. Claudius Burt, 102 Argyle Road, Ardmore, Pa.

HAVE LOOSE COUPLER, cost $8; 2000 ohm headset, cost $4.50; variable condenser, $3; Silicon detector, $2; fixed condenser 50c. Complete, $7.50. August Fischer, Westfield, N.J.

FOR SALE—1 Mignon R.C. 2 Receiving Cabinet, receives either damped or undamped waves from high powered stations; new, never used price $18. All letters answered. A. C. Jenkins, R.F.D., No. 5, Oxford, Ala.

FOR SALE—Annunciator wire, Flashlights, Switchboard, Printing Press, etc. Sydney Young, Jr., Addison, New York, R.F.D. 4.

I HAVE one pair skees with fasteners, never used, $5; Four foot Propeller, $5; rifle, $1; Relay, 50c; Hawkins' Guides, $9; jars, 25c; Wireless Age, electrical books, $2. Want good transmitting and receiving set. John Avritch, Grand Forks, N. Dak.

½ K.W. Transformer coil and electrolytic interrupter in fine condition, first money order for $6 takes both. Walter Alexander, Dunkerton, Iowa.

FOR SALE OR EXCHANGE—A Frank Holton Cornet, with case, costs $50 when new. Everything in excellent condition. The first good offer takes it. Veryl Ebert, Alden, Minn.

STOP! LOOK! SACRIFICE!—¾" Spark Coil, $1.25; Wheatstone's Bridge, $3; Large Voltammeter, $3; all rest E. I. Co. goods; $1 Key, 60c; Fixed Variable Condenser, 75c; 3, 15 Ampere D.P.D.T. Switches, 20c each; Ammeter, 40c; Hustler Motor, 40c; Receivers, 1000 ohm D.P., $1; 2, 75 ohm D.P., $1; 2, 75 ohm S.P., 60c. Satisfaction guaranteed. C. Krummenacker, 1034 73 St., Brooklyn, N.Y.

SELL OR TRADE for receiving instruments, Daisy Pump Gun, shot, target, $2.50. Post Card Projector (gas), $3. Write Claude Ireland, 3436 W. 60th Pl., Chicago.

WILL SELL slightly used 3" Bunnell coil equipped with large contacts for $8.50. Eugene Hartnell, Salem, Wis.

CRYSTALOI, half inch coil, phones, gap, lightning switch, step down transformers, two 22 repeating rifles, bicycle gas lamps, etc. Write for particulars. F. Stratford, Bentley Ave., Jersey City, N.J.

WANTED—15000 meter undamped wave coupler, good make. Chambers, 749 preferred. C. L. Brewer, Big Pool, Md.

FOR SALE—10 V. 8 A. dynamo, $8; Ducks 2" spark coil, $5; both in A1 condition. Arthur Sharpler, 109 Aborn Street, Providence, R.I.

MUST SELL—Cyclopedia of Applied Electricity, 7 volumes, never used. Howard Dellenbaugh, Pataskala, Ohio.

TRADE—4x5 Plate camera with $25 Lens and outfit for $20 or wireless apparatus. Everett Wosh, Long Pine, Neb.

WHAT AM I OFFERED for American Model Builder, No. 3; Brownie No. 2 Camera; Electrical Books? Rowena Davis, Paris, Tenn.

EXCHANGE OR SALE—2½" spark coils, Mesco and American Coil; 1, 3 P.D.T. switch, 9" by 9", slate base, 250 V. 50 A.; 1, S.P.D.T. switch, 2" by 10", slate base, 250 V. 75 A.; 1, 150 ohm Mesco relay. Everything first class condition. Wanted, 2 or 3000 ohm H-C head phones, Clapp-Eastham loose coupler. Spencer Burnham, 602 Oswego St., Ann Arbor, Mich.

SELL OR TRADE—Violin Outfit, Telegraphy Set and others. Send stamps for complete list. Wanted battery motor, Voltmeter. All letters answered. Harry De Laney, 122 Franklin Ave., Mansfield, Ohio.

FOR SALE—Good 45 Calibre Rifle, A1 condition. Write for particulars. Earl Cook, Bernardston, Mass.

WILL EXCHANGE—A Billiard Table 2½x5 feet complete, for an Audion. Percy Hall, 318 Milton Ave., Janesville, Wis.

9-A-E MY COMPLETE STATION FOR SALE, sold by piece or complete. I am offering some fine bargains, among them, brand new type $30 Thordarson Transformer, $23.50; Radio $23 Navy Coupler, $16; 3000 Holtzer Cabot fones, $7.50; 8000 revolution spark gap, cost $15, sell for $9; Paragon set, type O Crystaloi, $2.45; Tron Panel complete with bulb, $8.50; variometers, parts, etc., three double filament Electron Relay Bulbs, $3 each. Send for my printed sheet and particulars. Wanted, Roll Top Desk, ¼ H.P. to 1 H.P. Motors 110 V. A. C. Want five motors. Printing Presses. Paul J. McGee, Mattoon, Ill.

FOR SALE—Round double filament De Forest Audion Bulb, graphite potentiometer, Ferron detector, Rodiocite crystals, etc. All brand new and bargains. J. R. Dean, Rochester, N.Y.

FOR SALE—½ Kilowatt Packard, $13; 1 Kilowatt Rotary, $7; Marconi Type B Oscillation Transformer, $8; Arlington Receiving Transformer, $4; Ferron Detector, $2.50. All perfect condition. Write for list. Herman Werner, 41 Fay Street, Akron, Ohio.

WILL SELL OR TRADE my large Switchboard Voltmeter and Ammeter, each $8; Americanized Encyclopedia Britannica, $10; 3¼ by 4¼ camera, uses plates or films, very fine lens, $15; hot wire Ammeter, $2.75. Good Typewriter or gun needed. Wm. Leffler, Tiffin, Ohio.

FOR SALE OR EXCHANGE—Chamber's Loose Coupler, $3.50; Brandes Receiver, $1. Write for large list of wireless and experimental apparatus. All letters answered. Thomas Hannold, Paulsboro, New Jersey, R.F.D.

FOR SALE—Otis Clapp Statis Machine in first-class condition. Two 19" plates on hand operated end. Ten 29" plates on power operated end. Several Leyden jars and various discharging devices to go with machine. Cabinet measures 66"x66"x30" wide. All enclosed by glass, $75, f.o.b. Mattapan, Mass. Cost $450. Fritz Henrici, Mattapan, Mass.

SALE [illegible] nt Chordars, [illegible] also A A [illegible] ward 9 Forest, [illegible]

[illegible]ANGE—St[illegible] Rifle, barrel Shotg[illegible] and out- High Tension [illegible] agneto 1 cyl- Arthur Jenson, [illegible] Dak.

FOR SALE—1[illegible] Loose Coupler, [illegible]w, $3.50; 2 fine home-made loaders. 2000 and [illegible]00 meters, $1.25 and $1; 1" Bulldog spark coil, $3.50; telegraph sets; helix; Knapp Reversing Switch, 50c. Write me. All letters answered. Thomas Cumming, Sound Beach, Con.

HAVE—Induction [illegible] coil, No. 3 Erector, etc. Want variables, audion bulb, storage crystaloi ,etc. Write, Kenneth Marshall, Dowagiac, Mich.

WANTED—Late model twin motorcycle (Indian preferred) in exchange for 1/6, ¼, ½ A. C. motors. All letters answered. Enclose stamp. Tom Otis, Cedar Rapids, Iowa.

FOR SALE—Complete wireless 48 ft.; Arlington Transformer; Variable Condenser; Fixed Receiving Condenser; Electro Potentiometer; 1" spark coil; Pair Wireless Receivers; 600 volts lightning switch; all in good condition. B. Hajnacki, 1428 W. Superior St., Chicago, Ill.

AUDIO-TRON panel; Powers six motion picture machine, no lens; E.E. Half K.W. open core transformer with interrupter; 400 exposure kodak with stereopticon-enlarger, cost about $60; Make offer, cash, trade. Two filament tubular detector bulbs, $3.48. Hicks, Marion, Ill.

TRANSFORMER COIL with vibrator, $5 50; edgewound strip, $1; condenser plates, 70c; 2500 M. coupler, $4.50; sounder, $1; "Electrical Experimenter" 1915-16, $1.50; Ansco V. P. camera, $2. Want cash or Type D. tuner. Ralph Kunau, Sabula, Iowa.

FOR SALE—Audio-Tron Detector, brand new bulb, $5.50; 155 ft. aerial 2 copper wires, 10½" Electrose insulators, $2.50. Write, Harry Griffith, 5727 Broadway Ave., Chicago, Ill.

FOR SALE—4 Volumes Cyclopedia of Applied Electricity, $5.75; Thordarson step down transformer to 26 volts, $3.75; Base ball glove, 95c. Kenneth Houser, 631 N. Topeka, Wichita, Kansas.

FOR SALE—Transformer Coil Vibrator, 2 electrolytic Interrupters, 6 wet batteries. Excellent condition. All for $16. Rupert Keupf, Genesee, Idaho.

STEWART PHONOGRAPH—Brand new, cost $6, with popular records, $4.30. Carl Barnickol, 425 Davidson, Indianapolis, Indiana.

WANT MOTORCYCLE—Have $200 worth electrical and wireless apparatus to exchange. Coyd Maffet, Opal, Colo.

SALE OR TRADE—New 12 volt 10 ampere generator. Want Phones, Audion, Transformer, or what? G. Henningsen, W. 4th St., Fremont, Neb.

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the May issue should reach us not later than March 25.

OVER 75,000 PEOPLE READ THIS JOURNAL

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N.Y.

BOOKS

FREE HANDBOOK for mechanics and contractors in any line. Shows how to make your work easy; do more and better work and save money. State your occupation and the book is yours FREE. Van Expansion Bolt Company, 26 F West Lake St., Chicago.

30 MAGAZINES, value $3, all late issues, yours for 25c; all different. Eastern Bureau, New Egypt, N.J.

BIG INCOME Writing Advertising. Complete Course 18 lessons, only $1. Worth $10. Educational Bureau, New Egypt, N.J.

BE AN EXPERT SALESMAN. Get our Complete Copyrighted 15 Lesson Course, prepared by an expert and sent prepaid for only $1. Offer limited. Send at once. Johnston Pub. Co., 17 N. Greenmount Ave., Springfield, Ohio.

TO GET BETTER PICTURES—Read the Amateur Photographer's Weekly; illustrated; weekly prize competitions; print criticisms, many unique features; $1.50 per year; three months' trial subscription, 25c.; Abel Publishing Company, 401 Caxton Bldg., Cleveland, Ohio.

HELP WANTED

THOUSAND MEN AND WOMEN, 18 or over, WANTED everywhere, for U.S. Government Life Jobs. $75 month, Steady Work. Short hours. Rapid advancement. Common education sufficient. Write immediately for free list of positions now easily obtainable. Franklin Institute, Dep't A 27, Rochester, N.Y.

MISCELLANEOUS

ELECTRICIANS—Send 50c. for 16 Blue Prints of Motor and Generator Connections. 28 for $1, 10 A.C., 4 D.C. Motor Winding Diagrams for $1 or 20 A.C., 4 D.C. and 4 Rotary Converter Drawings, $1.60. Winding made easy. Martin Electric Co., 329 Irvington Pl., Denver, Colo.

CARTOONISTS WANTED—DON'T BE A JACK-OF-ALL-TRADES—MASTER ONE. Cartoonists earn from $25 to $200 per week. Talent or special education unnecessary. This School guarantees to make you successful. Send postal for test lesson and particulars. Dept 501, THE DENNON SCHOOL FOR CARTOONING, Harrison, N.Y.

EVERYBODY WANTS IT—Folding pocket Coat and Hat Holder. Can attach anywhere and remove instantly, nickel-plated. Sample 10c. Big seller for agents. Wedge Mfg. Co., "Km" Binghamton, N.Y.

STAMPS—75, all different, free. Postage 2c. Mention paper. Quaker Stamp Co., Toledo, Ohio

AGENTS—500 per cent profit putting initials on automobiles. Particulars sent free. Address, Auto Monogram Co., 2025 E. Monmouth St., Philadelphia, Pa.

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